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AUTHOR INDEX

Baer, Daniel J. 119
Breznitz, Shlomo 103, 169
Caldwell, Willard E. 85
Charles, Don C. 271
Cobb, Nancy J. 13
Cramer, Phebe 9
Donahoe, John W. 227
Doty, Barbara A. 203
Eisenberg, Jay 233
Field, Helen L. 13
Freeberg, Norman E. 245
Gale, Richard A. 119
Gauron, Eugene F. 263
Gillard, Betty Jo 29
Goss, Albert E. 13
Gottlieb, Nancy D. 85
Grossmann, Klaus E. 171
Harrell, Samuel N. 29
Heilbrun, Alfred B., Jr. 29
Henderson, Edmund H. 47
Henderson, Richard 233
Hill, John P. 233
Hindley, C. B. 161
Hodge, Milton H. 135
Hoff, Louis A. 135
Howard, Joyce L. 281
Impellizzeri, Irene H. 289
Keasey, Carol T. 271
Kleban, Morton H. 125
Krise, G. M. 241
Kugelmass, Sol 103, 169
Kuhlmann, William 233
Lewis, Nan 195
Linn, George B. 183
Livson, Norman 73
Long, Barbara H. 47
McDowell, A. A. 69, 241
Merchent, G. M. 69
Neimark, Edith D. 195
Payne, Donald T. 245
Peacock, L. J. 135
Perez, Vernon J. 219
Plant, Walter T. 281
Regan, Richard A. 151
Rowley, Vinton N. 263
Schmidt, Hans, Jr. 219
Stewart, Alan L. 219
Stotsky, Bernard A. 113
Strang, Harold R. 3
Stuart, Richard B. 59
Taub, Harvey A. 41
Tuckman, Jacob 151
Vandament, William E. 13
Ziller, H. H. 241
Ziller, Robert C. 47

TABLE OF CONTENTS

Relationship between focal point location and inversion perception at three age levels 3
By Harold R. Strang

The Stroop effect in preschool aged children: A preliminary study . . . 9
By Phebe Cramer

Acquisition of verbal responses in minimal paired-associates situations by young children 13
By Albert E. Goss, Helen L. Field, Nancy J. Cobb, and William E. Vandament

Perceived childrearing attitudes of fathers and cognitive control in daughters . 29
By Alfred B. Heilbrun, Jr., Samuel N. Harrell, and Betty Jo Gillard

Paired associates learning as a function of age, rate, and instructions . . 41
By Harvey A. Taub

Self-social correlates of originality in children 47
By Barbara H. Long, Edmund H. Henderson, and Robert C. Ziller

Decentration in the development of children's concepts of moral and causal judgment 59
By Richard B. Stuart

Fearfulness in the control and irradiated rat 69
By A. A. McDowell and G. M. Merchent

Towards a differentiated construct of curiosity 73
By Norman Livson

Magnetic field effects on the compass mechanism and activity level of the snail *Helisoma duryi endiscus* 85
By Nancy D. Gottlieb and Willard E. Caldwell

The development of intentionality in moral judgment in city and Kibbutz adolescents 103
By Sol Kugelmass and Shlomo Breznitz

Nursing home or mental hospital—Which is better for the geriatric mental patient? 113
By Bernard A. Stotsky

Intelligence and Bender Gestalt Test performance of institutional and noninstitutional school children 119
By Daniel J. Baer and Richard A. Gale

A test of the discrimination hypothesis: Utilization of response-reversals to test resistance to extinction for escape and intermittent escape conditions . . 125
By Morton H. Kleban

The effect of age and food deprivation upon the general activity of the rat . 135
By Milton H. Hodge, L. J. Peacock, and Louis A. Hoff

BOOKS RECENTLY RECEIVED 147

Size of family and behavioral problems in children 151
By JACOB TUCKMAN AND RICHARD A. REGAN

Racial and sexual differences in age of walking: A reanalysis of the Smith *et al.* (1930) data 161
By C. B. HINDLEY

The Guttman Scale as a means of testing Piaget's Theory of Development . 169
By SOL KUGELMASS AND SHLOMO BREZNITZ

Behavioral differences between rabbits and cats 171
By KLAUS E. GROSSMANN

Linguistic functions of bilingual Mexican-American children 183
By GEORGE B. LINN

The effect of incentives upon information gathering in diagnostic problem solving 195
By EDITH D. NEIMARK AND NAN LEWIS

Relationships among attitudes in pregnancy and other maternal characteristics 203
By BARBARA A. DOTY

Learned reduction of drinking latency 219
By HANS SCHMIDT, JR., ALAN L. STEWART, AND VERNON J. PEREZ

The effects of temporal variability on the reinforcing properties of visual stimulus change 227
By JOHN W. DONAHOE

Six- and ten-year-olds' attribution of punitiveness and nurturance to parents and other adults 233
By JAY EISENBERG, RICHARD HENDERSON, WILLIAM KUHLMANN, AND JOHN P. HILL

Effects of previous radiation exposure on the activity response to d-amphetamine hydrochloride 241
By A. A. McDOWELL, H. H. ZILLER, AND G. M. KRISE

Dimensions of parental practice concerned with cognitive development in the preschool child 245
By NORMAN E. FREEBERG AND DONALD T. PAYNE

Infantile shock traumatization and the mitigating effects of tranquilizing drugs 263
By EUGENE F. GAURON AND VINTON N. ROWLEY

Conservation of substance in normal and mentally retarded children . . . 271
By CAROL T. KEASEY AND DON C. CHARLES

Psychometric evaluation of an Operation Headstart program 281
By JOYCE L. HOWARD AND WALTER T. PLANT

Auditory perceptual ability of normal children aged five through eight . . 289
By IRENE H. IMPELLIZZERI

BOOKS RECENTLY RECEIVED 295

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VOLUME 27—January-June, 1943

1. Comparison of children's personality traits, attitudes, and intelligence with parental occupation—N. R. Maddy
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VOLUME 28—July-December, 1943

1. Separation anxiety in young children: A study of hospital cases—H. Edelston
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VOLUME 29—January-June, 1944

1. Mental changes after bilateral prefrontal lobotomy—S. D. Porteus and R. D. Kepner
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VOLUME 30—July-December, 1944

1. A method of administering and evaluating the thematic appreciation test in group situations—R. M. Clark
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VOLUME 31—January-June, 1945

1. The evolution of intelligent behavior in rhesus monkeys—B. Weinstein
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VOLUME 32—July-December, 1945

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2. A clinical study of sentiments: II.—H. A. Murray and C. D. Morgan

VOLUME 33—January-June, 1946

1. Interpretation of spontaneous drawings and paintings—T. S. Waehner
   Preferences for sex symbols and their personality correlates—K. Franck
2. Outstanding traits: In a selected college group, with some reference to career interests and war records—F. L. Wells and W. L. Woods

VOLUME 34—July-December, 1946

1. The relation of emotional adjustment to intellectual function—J. L. Despert and H. O. Pierce
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2. Finger-painting and personality diagnosis—P. J. Napoli

VOLUME 35—January-June, 1947

1. The thematic apperception technique in the study of culture-personality relations—W. E. Henry
2. A continuation study of anxiety reactions in young children by means of a projective technique—M. Dorkey and E. W. Amen
   A study of the vocational interest trends of secondary school and college women—A. M. Cawley

VOLUME 36—July-December, 1947

1. Maze test validation and psychosurgery—S. D. Porteus and H. N. Peters
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VOLUME 37—January-June, 1948

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   A study of the relationship between handwriting and personality variables—P. Castelnuova-Tedesco

VOLUME 38—July-December, 1948

1. Modern language learning: The intensive course as sponsored by the United States Army, and implications for the undergraduate course of study—M. Lind
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VOLUME 40—July-December, 1949

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   The relationship between level of vocational aspiration and certain personal data: A study of some traits and influences bearing on the prestige level of vocational choice—J. Stubbins

VOLUME 42—July-December, 1950

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VOLUME 43—January-June, 1951

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VOLUME 44—July-December, 1951

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VOLUME 45—January-June, 1952

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2. A statistical study of the Freudian theory of levels of psychosexual development—C. A. Barnes
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Genetic Psychology Monographs *(continued)*

VOLUME 46—July-December, 1952

1. The relationship of social status, intelligence, and sex of ten- and eleven-year-old children to an awareness of poverty—F. J. Estvan
   An empirical study of the castration and Oedipus complexes—S. M. Friedman
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VOLUME 47—January-June, 1953

1. Ability and accomplishment of persons earlier judged mentally deficient—D. C. Charles
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2. Some child-rearing antecedents of aggression and dependency in young children—R. R. Sears, *et al.*
   Symptom correlates for descriptive diagnosis—J. R. Wittenborn, *et al.*

VOLUME 48—July-December, 1953

1. Age and mental abilities: A longitudinal study—W. A. Owens, Jr.
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   Personality and physical disease: A test of the Dunbar hypothesis applied to diabetes mellitus and rheumatic fever—D. H. Crowell
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   A study of the effects of color on Rorschach responses—G. G. Brody

VOLUME 49—January-June, 1954

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VOLUME 50—July-December, 1954

1. A study of the relationship between play patterns and anxiety in young children—E. W. Amen and N. Renison
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1. Some relations between techniques of feeding and training during infancy and certain behavior in childhood—A. Bernstein
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   The Lincoln-Oseretsky Motor Development Scale—W. Sloan

VOLUME 52—July-December, 1955

1. Some personality correlates of sex, sibling position, and sex of sibling among five- and six-year-old children—H. L. Koch
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VOLUME 53—January-June, 1956

1. As the psychiatric aide sees his work and problems—F. L. Wells, M. Greenblatt, and R. W. Hyde
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2. Stress, fantasy, and schizophrenia: A study of the adaptive processes—O. J. B. Kerner
   The attitude structure of the individual: A Q-study of the educational attitudes of professors and laymen—F. N. Kerlinger

VOLUME 54—July-December 1956

1. A study of personality differences between middle and lower class adolescents: The Szondi Test in culture-personality research—L. Rainwater
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   A method for the comparison of groups: A study in thematic apperception—L. C. Schaw and W. E. Henry

VOLUME 55—January-June, 1957

1. Academic performance and personality adjustments of highly intelligent college students—B. M. Horrall
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   The rôle of mass media and the effect of aggressive film content upon children's aggressive responses and identification choices—R. S. Albert
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VOLUME 56—July-December, 1957

1. Some stable response determinants of perception, thinking, and learning: A study based on the analysis of a single test—M. L. Simmel and S. Counts
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1. Psychological and cultural problems in mental subnormality: A review of research—S. B. Sarason and T. Gladwin
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VOLUME 58—July-December, 1958

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Genetic Psychology Monographs *(continued)*

VOLUME 59—January-June, 1959

1. Freshman Rorschachs and college performance—G. R. Schmeidler, M. J. Nelson, and M. Bristol
   Perceptual aspects of attributed movement—R. W. Coan
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VOLUME 60—July-December, 1959

1. The constancy of personality ratings over two decades—R. D. Tuddenham
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VOLUME 61—January-June, 1960

1. Identifying socially maladjusted school children—A. A. Adams
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VOLUME 62—July-December, 1960

1. The reading process: A descriptive, interdisciplinary approach—M. P. Langman
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VOLUME 63—January-June, 1961

1. Make a sentence test: An approach to objective scoring of sentence completions—E. F. Borgatta
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   Conceptual thinking in schizophrenic children—G. Friedman
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   An investigation of trait relationships among six-year-old children—S. A. Avakian

VOLUME 64—July-December, 1961

1. Coping patterns of preschool children in response to intelligence test demands—A. Moriarty
   Studies of individual and paired interactional problem-solving behavior of rats: II. Solitary and social controls—A. Baron and R. A. Littman
2. Studies of role performance—J. H. Mann
   A psychological assessment of professional actors and related professions—R. Taft
   A cross-cultural study of menstrual taboos—W. N. Stephens
   The biological roots of creativity—H. Gutman

VOLUME 65—January-June, 1962

1. A Rorschach study of the development of personality structure in white and Negro children in a Southeastern community—A. C. Price
   Measuring personality patterns of women—J. Loevinger
   Home interests in early adolescence—M. Amatora
   Social and emotional adjustment during adolescence as related to the development of psychosomatic illness in adulthood—L. H. Stewart
2. A systematic study of interaction process scores, peer and self-assessments, personality and other variables—E. F. Borgatta
   Children's conceptions of the content and functions of the human body—E. Gellert

VOLUME 66—July-December, 1962

1. Ocular-manual laterality and perceptual rotation of literal symbols—I. Flescher
   Parental child-rearing attitudes and their correlates in adolescent hostility—S. B. Chorost
   Some explorations into the nature of anxieties relating to illness—P. R. Robbins
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   Achievement gains or losses during the academic year and over the summer vacation period: A study of trends in achievement by sex and grade level among students of average intelligence—K. M. Parsley, Jr., and M. Powell

VOLUME 67—January-June, 1963

1. Verbatim dialogue of a mother and child in therapy—C. E. Moustakas
   A study of self-concept: Delinquent boys' accuracy in selected self-evaluations—W. E. Amos
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2. Conceptual preferences associated with choice of quantitative and nonquantitative college majors—J. Gilbert
   A study of the concept of the feminine role of 51 middle-class American families—A. Steinmann

VOLUME 68—July-December, 1963

1. Brain dynamism as reflected in illusions—G. K. Yacorzynski
   The nature and measurement of components of motivation—R. B. Cattell, J. A. Radcliffe, and A. B. Sweney
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   The Gesell Incomplete Man Test as a measure of developmental status—L. B. Ames and F. L. Ilg
   Psychological and sociological factors in prediction of career patterns of women—M. C. Mulvey
   Functionalism and its historical significance—R. Harrison

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(Manuscripts are printed in the order of final acceptance)

Relationship between focal point location and inversion perception at three age levels 3
By Harold R. Strang

The Stroop effect in preschool aged children: A preliminary study . . . 9
By Phebe Cramer

Acquisition of verbal responses in minimal paired-associates situations by young children 13
By Albert E. Goss, Helen L. Field, Nancy J. Cobb, and William E. Vandament

Perceived childrearing attitudes of fathers and cognitive control in daughters . 29
By Alfred B. Heilbrun, Jr., Samuel N. Harrell, and Betty Jo Gillard

(OVER)

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Paired associates learning as a function of age, rate, and instructions . . 41
By Harvey A. Taub

Self-social correlates of originality in children 47
By Barbara H. Long, Edmund H. Henderson, and Robert C. Ziller

Decentration in the development of children's concepts of moral and causal judgment 59
By Richard B. Stuart

Fearfulness in the control and irradiated rat 69
By A. A. McDowell and G. M. Merchent

Towards a differentiated construct of curiosity 73
By Norman Livson

Magnetic field effects on the compass mechanism and activity level of the snail *Helisoma duryi endiscus* 85
By Nancy D. Gottlieb and Willard E. Caldwell

The development of intentionality in moral judgment in city and Kibbutz adolescents 103
By Sol Kugelmass and Shlomo Breznitz

Nursing home or mental hospital—Which is better for the geriatric mental patient? 113
By Bernard A. Stotsky

Intelligence and Bender Gestalt Test performance of institutional and noninstitutional school children 119
By Daniel J. Baer and Richard A. Gale

A test of the discrimination hypothesis: Utilization of response-reversals to test resistance to extinction for escape and intermittent escape conditions . . 125
By Morton H. Kleban

The effect of age and food deprivation upon the general activity of the rat . 135
By Milton H. Hodge, L. J. Peacock, and Louis A. Hoff

BOOKS RECENTLY RECEIVED 147

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RELATIONSHIP BETWEEN FOCAL POINT LOCATION AND INVERSION PERCEPTION AT THREE AGE LEVELS*

Bureau of Child Research, The University of Kansas

HAROLD R. STRANG

A. INTRODUCTION

The principal purpose of this study is to investigate the relatedness between the location of focal points[1] in nonrealistic figures and inversion perception of *S*s at varying age levels.

Contrary to the widespread Gestalt theory propounding that recognition of forms is independent of their spatial orientation, Ghent (3) has concluded that preschool children show a consistent preference for a particular orientation of realistic figures as right side up. In a subsequent study, Ghent and Bernstein (4) further concluded that preschool *S*s recognize geometric forms presented in the right-side-up position more frequently than when the forms are presented in inverted positions. Ghent (2) affirmed that preschool *S*s not only exhibit a constant preference for a particular orientation of realistic and geometric figures, but also for a number of nonrealistic forms. Ghent further hypothesized that the preschool child's orientation preference relates to the location of the primary focal points of the figures.

The present study is, in part, a replication of Ghent's (2) investigation. Two hypotheses were tested:

1. That a relatedness exists between the location of a primary focal point in nonrealistic figures and inversion perception responses emitted by preschool youngsters, primary school children, and adults.
2. That degree of conformity in the inversion-response patterns varies with age.

B. METHOD

*S*s from each of three age groups, preprimary (3-4 years), primary (5-8 years), and adult (college students), were asked to view sequentially 12 pairs of 3″ × 3″ white cards on an 8½-inch × 11-inch black background and to point to the figure of each pair that was "upside down" (Figure 1). All figures

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* Received in the Editorial Office, Provincetown, Massachusetts, on March 25, 1966.

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[1] A focal point is operationally defined as being an irregularity in the contour of a figure, as exemplified by the angle of a V, the point of intersection of T, or the rounded portion of a crescent.

were drawn in black. The two figures of each pair were structurally identical, but dissimilar in that one of the figures was presented as an inversion: that is, it was spatially turned 180 degrees from the other figure of the pair. Two types of figures were presented: realistic forms, pairs A and B; and nonrealistic forms, pairs C-L.

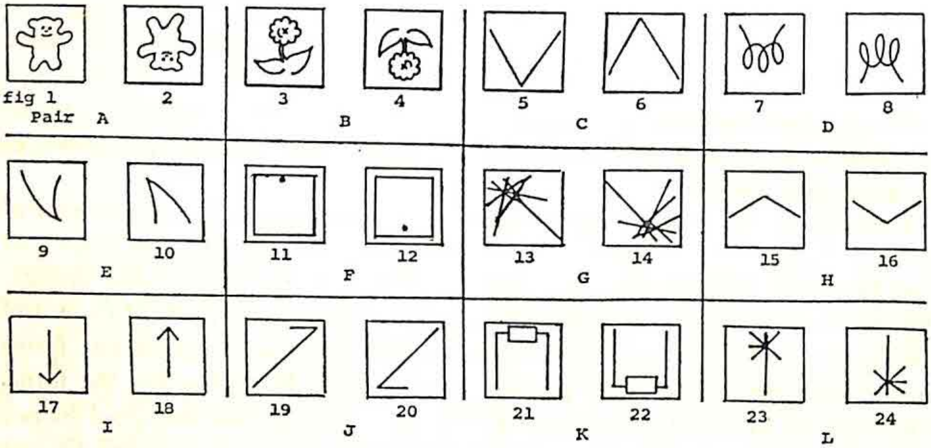

FIGURE 1
FIGURE PRESENTATION SERIES

The nonrealistic forms were carefully constructed so that the well-defined focal points of each figure would be located specifically in either the lower or upper half of the presentation card. Thus, if one of a figure pair illustrated a primary focal point in the upper half of its card, the inverted figure of the pair would illustrate a focal point in the lower half of the card (Figure 1). The decision as to whether the figure with its focal point situated in an upper position would occupy a right- or left-presentation placement was decided by referral to a table of random numbers (5, p. 238).

In the presentation of the paired series, the *S*s were tested singly. Each *S* was initially exposed to two pairs of realistic forms (Figure 1, Pairs A and B), so as to ascertain his preferential orientation for realistic figures. The succeeding test or nonrealistic sequence was arbitrarily established. The established sequence progression was invariably followed throughout the experiment.

An *S* was allowed to change his decision after making a response, if he did so before exposure to the next presentation. There was no time limit between presentation and response. A frequency count of inversion-recognition responses, per figure pair, per age level, and also an individual *S*'s response profile across the presentation series were obtained.

When referring to inversion-response frequencies, (R) will symbolize the total number of inversion responses, at an age level, for figures with primary focal points located in the lower position; (S) will symbolize the total number of inversion responses, at an age level, for figures with primary focal points located in the upper position. Thirty-five nursery school subjects age 3-4 years, drawn from the Nursery School at the University of Kansas; 36 first, second, and third graders (ages 5-8), drawn from the Buffalo, New York, public school system; and 39 college sophomore volunteers (mean age 23.8), drawn from an undergraduate educational psychology class at the University of Kansas, participated in this study.[2]

Both the preprimary and primary samples were sex-matched; the adult sample was not.

C. RESULTS AND DISCUSSION

To test the hypothesis that focal-point location is related to the observers' inversion responses at each of the age levels, a 1 × 2 chi square test of divergence was conducted. The ratio of the total number of inversion responses for figures with focal points located in the lower position (R) to the total number of inversion responses for figures with focal points located in the upper position (S) was tested against chance occurrence at each age level.

TABLE 1

TOTAL SERIES (R):(S) FREQUENCY X^2 TEST OF DIVERGENCE BY AGE LEVEL

Age level	*N*	(R) Total no. inversion responses for figures with focal pts. in lower position	(S) Total no. inversion responses for figures with focal pts. in upper position	X^2	*p*
Preprimary	35	300	50	250.0	.001
Primary	36	281	79	113.2	.001
Adult	39	306	84	12.4	.001

Note: In all chi square divergence analyses, observed total (R):(S) age-level frequency ratios were tested against expected ratios of 1:1 for significance of difference.

The chi square results presented in Table 1 demonstrates a relatedness between focal-point location and inversion responding in all age groups. (R) frequencies were higher than (S) frequencies at all age levels.

To test the universality of the focal-point/inversion-response relatedness with regard to individual figure pairs in the presentation series, a 1 × 2 chi square test of divergence for each figure pair at each level was conducted, and it yielded the results presented in Table 2.

---

[2] I wish to express my appreciation to Dr. John Dodd, SUNY College at Buffalo, for his assistance in obtaining grade-school data.

TABLE 2
INDIVIDUAL FIGURE PAIR (R):(S) FREQUENCIES AND X^2 ANALYSES OF DIVERGENCE BY AGE LEVEL

Figure pair	Preprimary frequencies (R)	Preprimary frequencies (S)	Primary frequencies (R)	Primary frequencies (S)	Adult frequencies (R)	Adult frequencies (S)
Realistic						
A	34	1***	36	0***	39	0***
B	35	0***	33	3***	39	0***
Nonrealistic						
C	27	8**	13	23	25	14
D	32	3***	35	1***	29	10**
E	29	6***	22	14	33	6***
F	29	6***	31	5***	30	9***
G	24	11*	29	7***	25	14
H	26	9**	25	11*	33	6***
I	34	1***	33	3***	29	10**
J	32	3***	29	7***	31	8***
K	33	2***	30	6***	33	6***
L	33	2***	34	2***	36	3***

Note: In all chi square divergence analyses, observed (R):(S) age-level frequency ratios were tested against expected ratios of 1:1 for significance of difference.
* Significant at .05 level.
** Significant at .01 level.
*** Significant at .001 level.

Inspection of the significance values found in Table 2 and of the (R) : (S) frequency pattern, per figure pair, per age level, revealed consistency due to the fact that *S*s, whether preprimary, primary, or adult, as a group, tended to respond to those nonrealistic forms with their focal points presented in the lower position—(R) types—as being inversions and to those figures with their focal points presented in the upper position—(S) types—as being right side up (one exception, Primary, Figure Pair C, Table 2).

The next hypothesis to be tested suggested that conformity of inversion recognition, as defined by (R) : (S) frequency, differs at the three age levels.

Three 2 × 2 chi squares were constructed, so as to test the independence of the total (R) : (S) frequencies across the age levels. Three comparisons were made: preprimary-primary, preprimary-adult, and primary-adult.

The results revealed that the total response patterns regarding (R) : (S) frequencies for all pairs of the series were significantly different (.02 level) when preprimary was compared with primary, and when preprimary was compared with adult; but no significant difference was found in the primary-adult comparison (Table 3). A comparison of the (R) : (S) response frequencies across age levels revealed that the total inversion-response pattern at the preprimary level exhibited the highest degree of conformity to the lower focal-point position, inversion-response hypothesis (Table 1).

TABLE 3
χ^2 TESTS OF INDEPENDENCE BETWEEN TOTAL (R):(S) FREQUENCIES ACROSS AGE LEVELS

Age levels compared	*df*	χ^2	*p*
Preprimary-Primary	1	5.52	.02
Preprimary-Adult	1	6.58	.02
Primary-Adult	1	.02	NS

Note: Total (R):(S) frequencies include the total number of (R) responses for all figures across the series per age level as compared with the total number of (S) responses per age level emitted.

The results of the present study confirm that focal-point location is a powerful universal discriminative cue in eliciting inversion recognitions in preschoolers, primary children, and adults. Whether the focal-point/inversion-perception paradigm is a result of innate determinism or of environmental conditioning is still an open question. The highest response conformity, found in the preschoolers, however, suggests that older children and adults, having been exposed to a more diversified history of pictorial stimuli, rely less upon focal-point location as a cue for inversion responding. To test the hypothesis that inversion conformity relates to younger children's limited exposure to a wide latitude of varied pictorial stimuli, a program of diversified pictorial exposure will be initiated with a group of preschoolers. The effects of the program will be assessed by comparing preprogram inversion recognition frequencies with postprogram frequencies.

The preschool results of this study are not in agreement with results obtained by Dodd and Strang (1). It is this writer's opinion that possible reasons for this disagreement may relate to the following design changes implemented in the present study: (*a*) the *E*'s increased familiarization with preschool *S*s prior to the testing, (*b*) a larger number of paired stimuli presentations, and (*c*) a more diversified program of stimuli presentations.

D. SUMMARY

Preprimary, primary, and adult *S*s were asked to make inversion recognitions when exposed to a series of 12 figure pairs. Each of the 10 figure pairs included in the study consisted of a nonrealistic figure with a prominent focal point

located in an upper position and a second structurally identical but 180-degree, spatially rotated figure.

At all age levels, the chi square analysis of divergence substantiated Ghent's hypothesis relating focal-point location and inversion responding, with lower focal-point positions relating positively to inversion recognition.

A chi square test of independence across the age levels revealed that more response conformity was to be found in the preprimary than in the primary or adult groups.

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THE STROOP EFFECT IN PRESCHOOL AGED CHILDREN: A PRELIMINARY STUDY*[1]

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A. INTRODUCTION

The Stroop color-word procedure (4) has been used in a variety of studies as a measure of interference due to competing response tendencies. On the test card (CW task), the *S* is presented with color words (e.g., RED, GREEN) printed in inks of incongruous colors (e.g., RED printed in blue ink). Characteristically, more interference has been found on the CW task when the *S* is required to say the colors than when his task is to read the words. This has been interpreted as reflecting the dominance of the word-naming habit over the color-naming habit. Evidence for this interpretation comes also from the fact that more time is required to name colors alone (C task) than to read words alone (W task).

A comprehensive review of this area by Jensen and Rohwer (3) revealed no published studies in this area with *S*s younger than 7 years, with the possible explanation that children younger than this age do not have well-enough established word reading habits to produce color-word interference [*cf.* (2)]. However this may be, it is certainly true that if a child cannot read, he cannot complete the word-alone (W) task.

Nevertheless, the consistent dominance of the word habit over the color habit for ages ranging from 7 to 80 (2) raises the question of whether this relative habit dominance would be found among younger children. On the basis of our knowledge that children between the ages of 3 and 6 prefer to sort objects on the basis of color rather than form (1), it seems reasonable to predict that the predominant *color* habit in this age group should cause less interference on the CW task when *S*s are required to name colors than when they are required to respond on the basis of some other, conflicting dimension. Accordingly, for the preschool aged *S*s of the present study, a Stroop-like test was constructed, in which the stimuli were incongruous color-forms, rather than color-words.

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[1] Appreciation is expressed to Amy Goldblatt for constructing the stimulus cards.

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B. METHOD

1. *Subjects*

The *S*s were 22 preschool aged boys ($N = 12$) and girls ($N = 10$), with a mean age of 4 years, 9 months (range 4-3 to 5-10). Although no independent measure of intelligence was made, the fact that these children were students in a university nursery school (i.e., their parents were faculty, staff, or students at the University) suggests that they were at least of average, and probably above average, intelligence.

2. *Materials*

Three 8½ × 11-inch cards were prepared as stimuli. On one, four patches of color (red, yellow, blue, green) were presented in random order in four rows and five columns, for a total of 20 colored patches. On the second card, four standard forms (apple, sun, water, tree) were also arranged in four rows and five columns, again in random order, with the exception that no form could occupy the same position as that of its appropriate color on the preceding card (e.g., apple could not appear in the same position as had red, previously). The third card consisted of four rows and five columns made up of colored forms. Each form was inappropriately colored (e.g., blue apple, green sun); the colors and forms appeared in the identical positions as they had on the colors-alone (C) card and on the forms-alone (F) card; thus if red occupied the ij^{th} position on the color card, and the tree form occupied the ij^{th} position on the form card, then on the color-form card (CF), a tree colored red occupied the ij^{th} position. An approximately equal number of each color-form combination was used.

3. *Procedure*

Each *S* was seated at a low table across from *E*. After instructions, a practice row of colors and of forms was presented to determine if the *S* had understood *E* and if *S* knew the names of the colors and forms. One *S* was discovered at this point to be color-blind and was removed from the sample. Another boy of similar age was substituted. Following this practice, the *S* was presented with either the C or the F card and called out the names of the colors (or the forms), while *E* followed on a mimeographed key sheet and recorded both the amount of time required to complete the 20 items and the number of errors made. After this first task, all *S*s were given the CF test. The 11 *S*s previously given the C card were requested to name again the colors on the

CF task, while the 11 *S*s previously given the F card named the forms on the CF task.

C. Results and Discussion

The results were analyzed for speed of reading colors alone, forms alone, and colors or forms on the CF interference task. Number of errors was also noted; however, the pattern of errors was highly similar across conditions and will not be discussed further.

The two groups were compared first for initial reading speed of colors alone (C task) *versus* forms alone (F task). The mean of 25.27 seconds ($SD = 6.73$) for colors did not differ significantly from that of 26.64 seconds ($SD = 6.57$) for forms. Thus although one of these concepts may be dominant for children of this age, this was not reflected in a differential reading speed for tasks requiring the independent use of the two concepts.

On the other hand, when the two concepts were combined on the CF task, their relative dominance produced different effects. For both interference conditions (reading colors or reading forms on the CF task), *S*s required more time for reading than when they read colors or forms, alone. For reading colors, this represented a mean increase from 25.27 to 36.09 seconds ($SD = 13.92$); for reading forms the comparable increase was from 26.64 to 31.00 seconds ($SD = 9.34$). A comparison of the distributions of difference scores indicated that all but one of the (CF-C) scores was positive; that is, it took the *S* longer to read colors on the CF than on the C task. However, more than half of the (CF-F) scores showed identical or *less* time taken to read forms on the CF than on the F task (most likely representing a practice effect). A t test of the difference between these differences approached significance ($p = .076$), indicating that there was more interference for reading colors than for reading forms on the CF task.

From these findings we can conclude that for this group of preschool children, form is the dominant concept. This inference is drawn from the fact that the greatest interference occurs when the child must suppress responding on the basis of form in order to make the color response. Much less conflict results from suppressing color in order to respond on the basis of form.

It is suggested that both the age and intellectual status of these children may have contributed to their form-dominance, which would not be expected to occur until a slightly later point in development. It is further suggested that by using this technique across a broader age and intellectual sample of children, it should be possible to locate that period in which the child changes from color to form dominance.

D. Summary

A modified Stroop test, adapted to the preschool level, was used in a preliminary study of the relative dominance of form *versus* color concepts in this age group. Greater interference was found when the *S*s were required to suppress the form response and respond on the basis of color than in the reverse condition, suggesting that form is the dominant concept.

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ACQUISITION OF VERBAL RESPONSES IN MINIMAL PAIRED-ASSOCIATES SITUATIONS BY YOUNG CHILDREN*[1]

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A. INTRODUCTION

The two experiments reported here are among a series of formal and less formal attempts to develop procedures with minimal paired-associates (PA) verbal situations that assure relatively rapid and complete acquisition of correct stimulus-response relationships by preschool-aged and kindergarten-aged children. A more specific objective of the present experiments was to test a procedure of informing *S*s of how well they are learning that does not involve the use of candy or toys as reinforcers.

One reason for development of procedures with minimal PA verbal situations that occasion relatively rapid and complete acquisition is to increase the likelihood of obtaining significant effects with variables of less than marked potency. Another reason is to maximize possible retention and transfer from acquisition of stimulus-response relationships in one situation to acquisition of such relationships in subsequent sessions involving the same or different situations. A related reason is to increase the time available for acquisition of stimulus-response relationships in subsequent situations. A fourth reason is to obtain the relatively rapid and complete acquisition in minimal PA situations prerequisite to effective experimentation with relatively complex PA and other situations.

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[1] Both of the experiments reported here were supported by a grant (MH 07315-01) from the National Institute of Mental Health. The apparatus employed was constructed by Joseph Mach. Helen L. Field was primarily responsible for execution of Experiment 1; Nancy J. Cobb and William E. Vandament were primarily responsible for execution of Experiment 2. Nancy Farrick Feldman aided in the data reduction, and Helen L. Rowell contributed both to the statistical analyses and to preparation of this report. Thanks for aid in obtaining children and for other contributions are due to Mrs. Barbara Southworth and Miss Jane Purseglove of the kindergarten of the First Congregational Church; to Miss Esther Strong; and to Miss Lorraine Benner of Mount Holyoke College, but then on the staff of the demonstration kindergarten at the Mark's Meadow School of the University of Massachusetts.

1. *Previous Experiments*

The two previous experiments of the series most pertinent to the present experiments were carried out by B. F. Nodine. The situation of the first of these experiments (5) involved the observed and presumed stimulus-response relationships shown in Paradigm B of Figure 1. The solid lines indicate relationships observed or presumed to be present initially. The broken lines indicate relationships whose strengthening is the criterion change. The dotted lines indicate some of the relationships whose strengthening might occur concomitantly. S_{11} and S_{21} are two stimuli presented in random order; they are observed or presumed to elicit $R_{S_{11}}$ and $R_{S_{21}}$, respectively. The "S" following these responses indicates response-produced stimuli. S_{11} is accompanied by

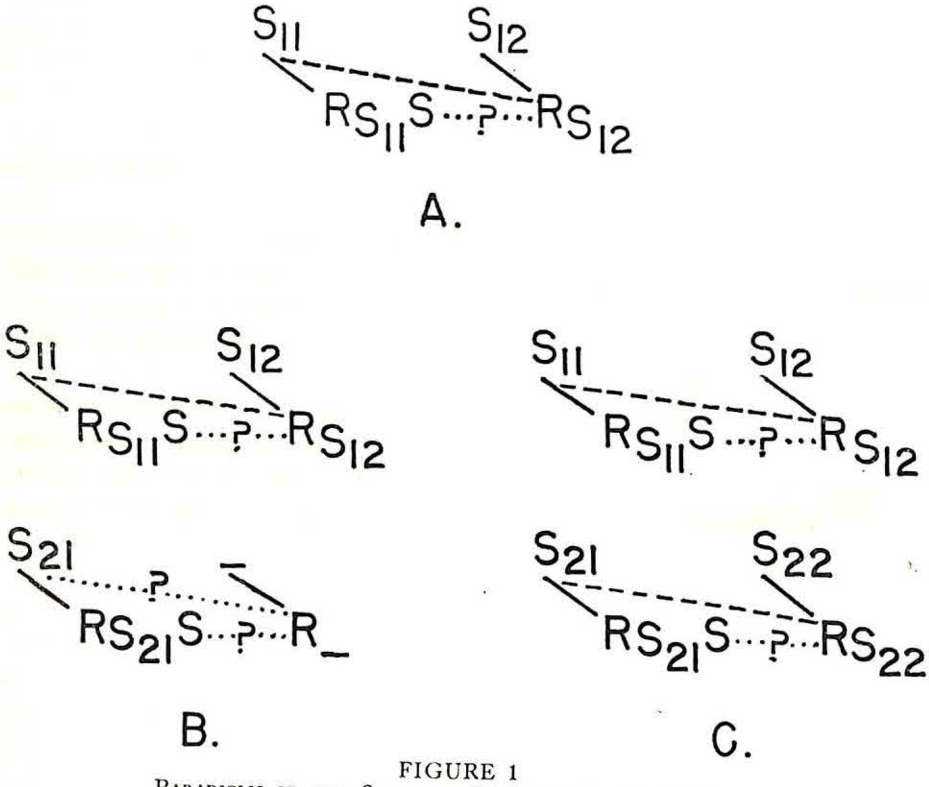

FIGURE 1
PARADIGMS OF THE STIMULUS-RESPONSE RELATIONSHIPS OF THE THREE MINIMAL PAIRED-ASSOCIATES SITUATIONS
The solid lines indicate relationships presumed to be present initially, the broken lines indicate relationships whose strengthening is the criterion change, and the dotted lines indicate some of the relationships whose strengthening might occur concomitantly.

another stimulus (S_{12}) that is observed or presumed to elicit $R_{S_{12}}$; S_{21} is not accompanied by any specific experimenter-controlled environmental change comparable to the occurrence of S_{12}. The blank indicates this, with R__ standing for any response that might occur during the interval after the presentation of S_{21} that is comparable to the interval in which S_{12} occurs after the presentation of S_{11}.

Specifically, S_{11} and S_{21} were illumination of orange and aqua lights, and S_{12}-R_{12} was *E* saying and *S*s repeating one of three English vowels, [i], [ʌ], or [u]. Subjects were instructed to associate the vowel with the light it accompanied. Sixty acquisition trials were administered to older and to younger preschool-aged boys and girls; 20 trials without S_{12}-R_{12} followed. Color of the light that was accompanied by S_{12}-R_{12} and the vowel used as S_{12}-R_{12} were additional variables.

Frequency and speeds of correct responses increased in typical, negatively accelerated fashion. However, terminal speeds were not as fast as seemed possible, and the younger children reached an apparent asymptote of only about 80 per cent correct responses. Of the four variables of age, sex, color of the light accompanied by S_{12}-R_{12}, and the vowel used as S_{12}-R_{12}, only age had a differential effect. Differential effects of the other three variables would necessitate more complex experimental designs. Hence, their non-significant effects were not only the expected but also the desired outcome. Omission of S_{12}-R_{12} did not bring about fewer correct responses or slower speeds than did inclusion of S_{12}-R_{12}.

The situation of B. F. Nodine's second experiment (6) involved the observed and presumed stimulus-response relationships shown in Paradigm C of Figure 1. S_{11} and S_{21} were two stimuli, again orange and aqua lights, presented in random order, each accompanied by a different stimulus, S_{12} or S_{22}, now two rather than one of the same three vowels. The variables of primary interest were percentages of occurrence of S_{12} and S_{22} (Per cent ORM), and percentage of occurrence of prompting the children to increase speed (Per cent Prmpt). Per cent ORM was selected as a variable because of its pronounced effects on PA learning by adults (3). Per cent Prmpt was introduced on the possibility that it would function as "knowledge of results" (1) to increase response speeds.

Age and sex were again treated as variables. The former was included partly because of its differential effect in the previous experiment and partly because older children were expected to react more consistently to prompting than were younger children. Sex was not expected to have differential effects, but was included on the possibility of interactions with Per cent ORM, Per cent

Prmpt, or Age. The 60 acquisition trials under one of the four combinations of 50 per cent or 100 per cent ORM and zero per cent or 50 per cent Prmpt were followed by 20 trials under zero per cent ORM and zero per cent Prmpt.

Significant increases through the 60 acquisition trials were obtained for frequency of correct responses but not for speeds of correct or of all responses. Even for correct responses, older children reached a level of only 77 per cent correct responses and younger children attained a level of only 65 per cent correct responses. Thus, achievement in terms of correct responses was lower than is desirable for ascertaining effects of other variables and for experiments on retention and transfer.

Age was the only variable significant for all three response measures, with older children making more correct responses and responding faster than younger children. Per cent Prmpt was related directly to speeds of correct and of all responses by older children; it had no effect on speeds of responses by younger children. Either alone or in combination with the other variables, Per cent ORM and sex had no consistent significant effects.

The shift from the acquisition combinations of Per cent ORM and Per cent Prmpt to the possible extinction combination of zero per cent ORM and zero per cent Prmpt brought about no decrements in frequencies of correct responses or speeds. Thus, as in the previous experiment with children and in experiments with adults (2), conditions that might be considered homologous to those that produce experimental extinction in classical conditioning did not occasion decrements in frequencies of correct responses acquired in these minimal PA situations.

The results of these experiments were further demonstrations of children's acquisition of verbal responses to nonverbal stimuli. But, despite the simplicity of the PA situations employed, terminal levels of the younger children with Paradigm B, and terminal levels of both older and younger children with Paradigm C were lower than was desired and is desirable. Hence there was a need for additional experiments with the primary objective of development of procedures that would assure more rapid and better acquisition than was possible in previous experiments.

2. *Present Experiments*

The minimal PA situations of the present experiments were those employed by Nodine in her first and second experiments along with a third paradigm, designated Paradigm A. The observed and presumed stimulus-response relationships are also shown in Figure 1. The stimulus-response relationships of Paradigm A resemble those of paradigms of simple classical conditioning or simple associative reaction-time situations. The stimulus-response relationships of Paradigm B resemble those of the paradigms of simple differential classical conditioning or *c*-type, disjunctive, reaction-time situations. And the stimulus-response relationships of Paradigm C resemble those of the paradigm of the *b*-type, disjunctive, reaction-time situation. One reason for the use of all three minimal PA situations was their structural resemblance to these several traditionally important simple situations. Another reason was to permit comparisons among the three minimal PA situations, from which more information about acquisition with each situation might be derived than would be possible with any one of them singly.

Age and sex were combined with paradigms. Age was varied because of previous findings of the effectiveness of this variable. Although sex was treated as a variable, differential effects were not expected. From the viewpoint of ease of experimentation, being able to disregard children's sex is advantageous. Experiments 1 and 2 differed in several details. These differences are noted in the description of method for Experiment 2.

B. EXPERIMENT 1

1. *Method*

a. Apparatus, stimuli and responses. The apparatus was housed in a portable wooden box with front and back panels about 24 inches × 18 inches, and 12½ inches in depth. Protruding from the upper center of *S*s' side of the box was a short tube. An orange or an aqua light appeared occasionally for a short period in the round translucent window at the far end of the tube. Within the box were a voice key, electronic clock, movable frame containing the filters for producing the orange and aqua lights, and an electromechanical device for controlling occurrence and duration of the lights. The microphone leading into the voice key was held by the children. To prevent them from dropping the microphone, a loop of ribbon, attached to the support of the microphone, was placed over their heads and around their necks.

The responses required of the children were the vowels [i] and [u]. Insofar as possible, pairings of lights and vowels were counterbalanced. The colors were very different; the vowels were dissimilar and probably among the phonemes of greatest strength in children's repertoires. Thus, in terms of stimuli and responses, it is doubtful that appreciably easier specific PA tasks could have been realized within Paradigms A, B, and C.

Nodine (5, 6) did not use candy or toy reinforcers contingent on occurrence of particular responses. However, in order to hold the children's attention and cooperation she did let them choose among toy rewards after every 20 trials. That reinforcers were not made contingent on occurrence of particular responses was considered a possible reason for the children's failure to learn at the rates and to the levels desired and considered possible. However, some preschool teachers object to use of toys as reinforcers, and many object to, and some forbid, use of pieces of candy as reinforcers. Less formal preliminary experimentation had indicated that illumination of a colored light would serve as a reinforcer specific to occurrence of correct responses. Therefore, a panel with a line of 10 Christmas tree lights of assorted colors, none similar to orange or aqua, was added to the apparatus. The bulbs were of the blinking type.

b. Procedure. After being brought into the room in which the box was located, *S*s were seated in front of the box and the task was explained to them. The loop attached to the microphone was placed around their necks, and they were shown how and in what position to hold the microphone.

Each child's ability to imitate the vowel sound(s) was then tested, after which the stimuli were presented in Paradigms A, B, or C. On each trial the orange or aqua light came on for three seconds, after which *E* said the vowel accompanying that light, which *S*s repeated. In Paradigm A, *S*s experienced only one of the lights and only one of the vowels. In Paradigm B, they experienced both lights which alternated in one of Gellerman's (4) orders for blocks of 10 trials. Only one of the lights was accompanied by a vowel. In Paradigm C, the two lights alternated in the same order, with each accompanied by a different vowel.

Presentations of successive PA units or trials with Paradigms B and C occurred at a rate of six per minute. Since four to five seconds was required for the light-vowel sequence, the interunit interval was five to six seconds. Preliminary exploration had indicated that further reduction in the interunit interval was impractical from the viewpoint of time for *E* to record latencies and to change lights. With Paradigm A, each occurrence of the aqua light or of the orange light to initiate a trial was separated by the same interval that separated the same two ordinal occurrences of the particular light in Paradigms B and C.

Each time *S*s responded correctly, one of the 10 colored lights on the panel went on. Each time *S*s responded incorrectly, the most recently illuminated light was turned off. The criterion set for *S*s was to turn on all 10 lights.

c. Subjects and experimenter. Older children were obtained from among those attending the cooperative kindergarten housed in the First Congregational Church of Amherst. Younger children were obtained from among those enrolled in Miss Strong's private nursery school. Although from different schools, the *S*s were from equivalent home backgrounds. Furthermore, some of the older children had previously attended Miss Strong's school. Usable data were obtained for 18 older boys and 15 older girls. Because of non-cooperativeness, protocols of two other older girls were discarded. Usable data were obtained for nine younger boys and seven younger girls. Table 1 shows the means and ranges of ages in months of both older and younger boys and girls assigned to each paradigm. Although unintentional, means of ages for *S*s assigned to Paradigm C tended to be slightly higher than those for *S*s assigned to Paradigms A and B.

TABLE 1
MEANS AND RANGES OF AGES IN MONTHS OF OLDER AND YOUNGER BOYS AND GIRLS ASSIGNED TO EACH OF THE PARADIGMS IN EXPERIMENTS 1 AND 2

Paradigm	Age	Sex	Exper. 1 *N*	Exper. 1 Mean	Exper. 1 Range	Exper. 2 *N*	Exper. 2 Mean	Exper. 2 Range
A.	Older	Boys	6	70	65-75	4	72	66-78
		Girls	5	68	65-71	4	66	60-72
	Younger	Boys	4	51	44-56	4	52	42-60
		Girls	2	53	42-64	4	44	35-58
B.	Older	Boys	6	72	65-74	4	69	67-76
		Girls	5	68	66-71	4	73	69-76
	Younger	Boys	3	55	49-59	4	42	33-58
		Girls	3	55	49-59	4	43	33-52
C.	Older	Boys	6	76	72-79	4	73	67-78
		Girls	5	74	73-75	4	72	67-77
	Younger	Boys	2	48	46-49	4	48	38-52
		Girls	2	61	59-63	4	44	36-51

The *E* was a woman in her late thirties with a master's in psychology and with prior experience in the psychological testing of *S*s of various ages. She has three children and was familiar to all of the older children and to some of the younger children.

2. *Results*

Acquisition was scored in terms of number of presentations of units or trials through the criterion of turning on all 10 lights. Because of the discrimination required with Paradigms B and C, longer latencies were expected for these paradigms than with Paradigm A, irrespective of occurrence of correct responses. Thus, latency of responses was considered less a measure of acquisition and more a measure of performance. For this reason, and because of different numbers of trials through criterion, latencies were expressed as the median of those for the last 10 responses. While these responses were not necessarily correct, from most to all were correct.

Means of number of trials through criterion and of latencies for each of the combinations of paradigms, age, and sex are shown in Table 2. In order to obtain approximate proportionality of cell frequencies for the analyses of variance, an *S* was eliminated from two combinations involving younger children (Paradigm A, boys; Paradigm B, girls). Also, the means for the two *S*s in Paradigm C, younger boys, were added as third scores for this combination. The resultant changes in the means for the two former combinations, respectively, of .1 and 2.3 for trials to criterion and of .06 and .10 for latencies, were too small to have influenced outcomes of the statistical analyses as were the deviations from proportionality.

TABLE 2
MEANS OF TRIALS THROUGH CRITERION AND OF MEDIANS OF LATENCIES OF THE LAST 10 RESPONSES FOR EXPERIMENTS 1 AND 2

Paradigm	Age	Sex	Trials Exper. 1	Trials Exper. 2	Latencies Exper. 1	Latencies Exper. 2
A.	Older	Boys	12.7	11.2	1.04	0.85
		Girls	11.2	12.0	0.80	0.98
	Younger	Boys	10.3	14.2	1.18	1.35[a]
		Girls	13.5	23.2	1.60	1.55
B.	Older	Boys	23.5	35.5	1.35	1.84
		Girls	16.6	22.0	1.75	0.57
	Younger	Boys	20.7	45.5	1.67	1.63
		Girls	13.0	47.0	1.80	2.16
C.	Older	Boys	23.8	32.8	1.35	0.97[a]
		Girls	20.2	37.8	1.60	1.77[a]
	Younger	Boys	19.0	34.2	1.62	2.05[a]
		Girls	16.0	37.5	1.70	1.97

[a] Because of failures of the timer, the latencies for one of the four *S*s in the combination could not be determined. For the analysis of variance, missing values were replaced by cell means.

Number of correct responses among the last 10 responses were also determined. These scores did not require statistical analysis.

a. Trials through criterion. Beyond the second or third trial with Paradigm A, almost all *S*s in all four combinations of age and sex responded without further error. With Paradigms B and C, means of trials through criterion were from about 20 per cent to about 100 per cent higher than those for the same combinations of age and sex with Paradigm A. Disregarding age and sex, means for Paradigms A, B, and C were 11.9, 19.5, and 20.8, respectively.

For combinations of age and sex within paradigms, no marked or systematic differences among means occurred.

The analysis of variance on trials through criterion with paradigms, age, and sex as variables is summarized in Table 3. Because of the estimated score, *df* for error was 35 rather than 36. The only significant *F* was for paradigms; it was due to slower acquisition with Paradigms B and C than with Paradigm A.

b. Latencies. Disregarding age and sex, the mean of 1.06 with Paradigm A was lower than the mean of 1.59 with Paradigm B and of 1.52 with Paradigm C. The *F* for paradigms was significant.

Within each paradigm, older boys and older girls responded faster than younger boys and younger girls, but the latencies for boys and girls did not differ consistently. Disregarding paradigms and sex, the difference of .27 between the means of 1.31 for older children and of 1.58 for younger children was also sufficient to produce a significant *F*. None of the remaining *F*s was significant.

c. Correct responses. As mentioned before, beyond the second or third trial with Paradigm A, almost all of the older and younger boys and girls responded without further error. With Paradigm B, all but one of the older boys, all of the older girls, and all of the younger boys and girls responded correctly during all 10 of the last 10 trials. With Paradigm C, all but one of the older boys, all but one of the older girls, and all of the younger boys and girls responded correctly during all 10 of the last 10 trials. Thus, with all three paradigms, both older and younger *S*s were responding correctly at a high level in a relatively small number of trials. Because no appreciable differences obtained among combinations of paradigms, age, and sex, statistical analysis was unnecessary.

C. EXPERIMENT 2

1. *Method*

a. Apparatus, stimuli and responses, procedure. With one exception, the apparatus, and the stimuli and responses were those of Experiment 1. In Experiment 1, some *S*s expressed concern about the lights going on and off. Consequently, the blinking lights were replaced by nonblinking ones. The procedure was that of Experiment 1.

b. Subjects and experimenters. The older *S*s of Experiment 2 were drawn primarily from a demonstration kindergarten being conducted at the Mark's Meadow School on the campus of the University of Massachusetts. Additional older children and the younger children were obtained from among those

TABLE 3
ANALYSES OF VARIANCE ON TRIALS THROUGH CRITERION AND ON LATENCIES
(All *F*s for interactions < 2.50 omitted)

		Trials				Latencies			
		Exper. 1		Exper. 2		Exper. 1		Exper. 2	
Source	*df*	*MS*	*F*	*MS*	*F*	*MS*	*F*	*MS*	*F*
Paradigms (P)	2	372.65	4.70*	2444.64	8.39**	1.33	15.80**	0.90	1.84
Age (A)	1	65.24		850.09	2.92	0.73	8.70**	4.66	9.49**
Sex (S)	1	137.57	1.74	12.00		0.24	2.87	0.01	
Experimenter (E)	1			48.00				0.38	
P × A × S	2							1.34	2.73
P × A × E	2			791.06	2.72				
Error	[a]	79.21		291.33		0.084		0.49	

[a] *df* for analyses from left to right 35, 24, 35, and 20, respectively.
* $p \leqslant .05$.
** $p \leqslant .01$.

whose parents lived at the three housing facilities on the University campus. Means and ranges of the ages of the four older and younger boys and girls assigned to each paradigm are also shown in Table 1.

The children of Experiment 2 were drawn from different sources and thus participated in different places than those of Experiment 1. These differences in source and place might have been important. They also reflected at least three other differences of possible but unknown importance. One was that the children of Experiment 2 had markedly less experience in kindergarten and in preschool than had the children of Experiment 1. In fact, some of the younger children of Experiment 2 had not attended preschool. A related difference was more younger children below 48 months of age in Experiment 2 than in Experiment 1, and greater ranges of their ages. A further difference was in the characteristics of parents and families. In general, the parents of the children of Experiment 1 were older and had lived longer in the community than had the parents of the children of Experiment 2. Also, more of the children of Experiment 1 than of Experiment 2 were from families of more than one child.

The children of Experiment 2 were run by two *E*s, a female in her early twenties, and a male in his early thirties. Both were graduate students in psychology with some and a great amount of experience in testing children, respectively. Each ran two children in each of the 12 combinations of paradigms, age, and sex. Pairings of lights and vowels were counterbalanced across the four *S*s in each combination but, within each combination, were confounded with *E*s.

2. *Results*

a. Trials through criterion. When age and sex were disregarded, fewer trials through criterion were required with Paradigm A ($\overline{X} = 15.2$) than with Paradigms B ($\overline{X} = 37.5$) and C ($\overline{X} = 35.6$). The *F* for paradigms was significant at .01. The mean of 25.2 for older children was lower than that of 33.6 for younger children, but the difference was not significant. The *F*s for sex and for *E*s (confounded with pairings of lights and vowels) were not significant nor were there significant interactions.

b. Latencies. The *F* for differences in latencies among paradigms was not significant. However, *S*s did respond faster with Paradigm A ($\overline{X} = 1.22$) than with Paradigm B ($\overline{X} = 1.55$) or with Paradigm C ($\overline{X} = 1.67$). Older children ($\overline{X} = 1.16$) responded with significantly lower latencies than the younger children ($\overline{X} = 1.79$). Sex and *E*s did not have differential effects; nor was any interaction significant.

c. Correct responses. With Paradigm A, most of the *S*s responded correctly within a few trials and continued to respond almost perfectly. With Paradigm B, two of the older boys and all four of the older girls responded correctly during all 10 of the last 10 trials; the other two older boys responded correctly during only eight of these trials. The means of 9.0 and 10.0 correct responses during the last 10 trials for boys and girls, respectively, were substantially the same as the means of 9.2 and 9.0 for younger boys and girls, respectively. One of the younger boys and two of the younger girls failed to respond perfectly.

With Paradigm C, none of either the older or the younger boys and girls responded correctly during all 10 of the last 10 trials. The means were 7.0, 7.5, 6.2, and 6.5 for all four *S*s of the combinations of older boys, older girls, younger boys, and younger girls, respectively. However, in each of three of the four combinations, all but one of the four *S*s made eight or more correct responses. The exceptional *S*s made only zero, one, or three correct responses. With these *S*s eliminated, the means of 7.0, 6.2, and 6.5 were all raised to 8.3. Because the only consistent and marked differences were in the lower means with Paradigm C, statistical analysis did not appear necessary.

D. DISCUSSION

Results of Experiments 1 and 2 are examined and compared. They are then related to those obtained by Nodine (5, 6).

1. *Experiments 1 and 2*

In both Experiment 1 and Experiment 2, fewer trials were required through criterion, and the last 10 responses were faster with Paradigm A than with Paradigms B and C. Three of the four *F*s for paradigms were significant; the exception was the *F* for latencies in Experiment 2. In Experiment 1, overall means of trials through criterion for Paradigms B and C were less than twice the overall means for Paradigm A. Thus, number of trials per unit through criterion was slightly less with Paradigms B and C than with Paradigm A. In Experiment 2, however, the overall means of trials through criterion for Paradigms B and C were about two and one-half times the overall mean for Paradigm A. These results, though not those of Experiment 1, suggest that introduction of a second stimulus and, hence, a discrimination in Paradigm B, and of a second PA unit in Paradigm C, increased the number of trials per unit. These same differences between Paradigm A and Paradigms B and C are the presumed bases for the longer latencies in the latter two paradigms.

Differences between Paradigms B and C in trials to criterion and latencies were slight and inconsistent.

The apparent comparability of rates of acquisition with Paradigms B and C is not consistent with expectations based on classical findings of shorter reaction times with *c*-type disjunctive situations than with *b*-type disjunctive situations (7). With Paradigm B, some children responded to S_{21}, not with silence but with overt responses such as "Nothing." On other trials, these *S*s and perhaps other *S*s may have responded in similar fashion covertly. Were this the case, Paradigm B might not have been as different from Paradigm C as indicated by differences in experimental conditions.

Older children required fewer trials to criterion and responded faster during the last 10 trials in both experiments. The differences in latencies were significant, but those for trials were not significant. As expected and desired, overall differences between boys and girls were nonsignificant and sex entered into no significant interactions.

An additional factor in Experiment 2 was *E*s confounded with pairings of lights and vowels. Fortunately, from the viewpoint of consistency of results and their interpretation, neither the overall *F* for *E*s thus confounded nor any of the interactions involving these confounded variables was significant.

The pattern of results for Experiment 1 resembled that for Experiment 2. However, across paradigms and for each paradigm, particularly Paradigms B and C, children in Experiment 1 required fewer trials through criterion than those in Experiment 2. Also, the overall mean of 9.3 correct responses for older children in Experiment 2 was slightly lower and the overall mean of 6.8, or of 8.1 with three *S*s excluded, were clearly lower than the corresponding means of 9.8 and 10.0 for children in Experiment 1.

A possible basis for the more rapid and better acquisition in terms of correct responses by children in Experiment 1 than in Experiment 2 was greater sophistication in playing games, due, in turn, to more extensive prior experience in preschool or preschool and kindergarten. Greater familiarity of the *S*s with the *E* of Experiment 1 than of the *S*s with the *E*s of Experiment 2 was an alternative or an additional factor.

2. *Relationship to Previous Experiments*

Rather than terminating acquisition when a certain level or outcome of correct responses had been attained, Nodine (5, 6) administered 60 trials to all *S*s. Plotting curves of acquisition is usually easier with the latter manner of administering trials. For investigations of retention and transfer, however, administering acquisition trials through attainment of a certain level or outcome of correct responses seems preferable due to the fact that, with a fixed number of trials, administering too many trials increases the proportion of *S*s who have overlearned, and administering too few trials reduces the proportion of *S*s who have reached the fairly high levels of strength that are often desired.

Nodine's experiments were partly concerned with form of the curves. The concern of the present experiments was that *S*s attain a high level of responding correctly in a relatively small number of trials. Thus, the manner of administering trials was changed to presentations through turning on 10 lights. Because of the differences in administering trials, Nodine's results and results of the present experiments are not strictly comparable. However, examination of correct responses per block of 10 trials by the younger children of Nodine's first experiment, which was with Paradigm B, suggested that their apparent asymptotic responding was not at the levels attained by the younger children in both of the present experiments. A similar conclusion seems tenable with respect to the apparent asymptotic responding of the older and younger children of her second experiment, which was with Paradigm C, and, respectively, terminal responses of the older and younger children in the present Experiment 1. Also, both the younger and the older children of the present Experiment 2 were responding at terminal levels approximately equal to those of the children of like age in Nodine's second experiment. With both paradigms, markedly fewer trials were administered in the present experiments than in her experiments. Thus, acquisition in Experiments 1 and 2 was seemingly faster and to generally higher terminal levels than previously, which suggests that turning on lights may be a procedure to facilitate acquisition that does not have the objectionable features of use of toys or candy reinforcers.

E. SUMMARY

The three minimal paired-associates situations used to investigate acquisition of verbal responses by young children involved acquiring a single response to a single stimulus, acquiring that same response to the same stimulus but not to a second stimulus, and acquiring a different response to each of the two stimuli. Designated Paradigms A, B, and C, respectively, the stimuli were orange and aqua lights; and the responses to be acquired were the English vowels [i] and [u], said by *E* and repeated by *S*s. Different groups of older and younger boys and girls learned with each paradigm until all 10 lights on a panel had been lit; correct responses turned on a light, incorrect responses turned off a light. With respect to most aspects of method, the experiments were the same.

In both experiments, fewer trials were required through criterion and the

last 10 responses occurred faster with Paradigm A than with Paradigms B and C. Trials and latencies with Paradigms B and C were substantially the same. During the last 10 trials, most to all responses were correct.

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PERCEIVED CHILDREARING ATTITUDES OF FATHERS AND COGNITIVE CONTROL IN DAUGHTERS*

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A. INTRODUCTION

The childrearing influence of the father upon subsequent adjustment of the child has not been pursued with nearly the vigor that has characterized maternal childrearing research, probably for a variety of reasons. Few would wish to defend the contention, however, that the disproportionate emphasis necessarily represents the relative contribution of the mother and father to all behavioral outcomes in the child. Accordingly, a concerted effort to study the father's role in the child's development should accompany the continuation of inquiry into maternal variables. The complex relationships between the behaviors of the parents considered concomitantly and adjustment outcomes of children also remain relatively unexplored.

Scrutiny of two recent reviews of parent-child research (2, 5) reveals little evidence that paternal behavior is systematically related to psychopathology of the offspring aside from the gross contingencies between passive, ineffectual qualities in the father and schizophrenic disorders among children. The combination of a weak father and a dominant, rejecting mother represents one of the few replicated observations of concomitant parental attributes in psychopathogenesis, although Frank's (5) pessimistic conclusion from his research review would dissuade the reader from placing much credence in any parent-child contingency as antecedent to a specific disorder or even to psychopathology in general.

Heilbrun and his associates have adopted a research procedure that to date has proven fruitful in clarifying relationships between parental childrearing attributes and deviant behaviors of late-adolescent, grossly normal offspring. One guiding principle of the research has been that the study of deviant behavior within normal populations represents the most parsimonious route to

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[1] This research was conducted while the senior investigator was a faculty member at the State University of Iowa.

the understanding of serious behavior pathology. This principle, previously articulated by other researchers (e.g., 1, 18), has been cogently summarized as follows:

> Our social-learning principles seek to explain deviant behavior in terms of classes of events that appear to be equally important for the establishing of nondeviant patterns of response. This approach carries the implication that the distinction between deviant and nondeviant behavior represents a value judgment and that categorical value judgments of this nature, though important for determining the decisions and actions of agents of social control, are of little theoretical significance (1, p. 44).

A second procedure, which has been maintained standardly throughout the senior investigator's research, has been the reduction of parental childrearing behaviors to two broad dimensions—control and nurturance—in line with the proposals of other workers (19, 20, 23), with the same instruments used for their measurement in all studies. Keeping the subject attributes and techniques of measurement constant has allowed for direct comparison of results obtained over all investigations.

Another consistent procedure maintained for all studies has been the use of the child's perception of parental childrearing attributes as the independent variable. Dissatisfaction with questionnaire approaches to assessment of childrearing behaviors, as exemplified by Becker and Krug's recent report (3), appears to be generally based upon the lack of fruitfulness attendant to self-descriptive techniques. It begins to appear that if we are interested in predicting response outcomes of the child based upon childrearing experience, we would be wiser to use the child's interpretation of that experience rather than that of the parent. Prediction toward one response system from a second response system within the same individual certainly holds greater promise than prediction from the responses of another person.

Research by Heilbrun and his associates has focused primarily upon the relationships between perceived maternal childrearing practices and the socially reinforced behaviors of the offspring. The Parent Attitude Research Instrument (PARI) (22) and Parent-Child Interaction Rating Scales (7) have been standardly employed to define perceived maternal control and nurturance, respectively, with subjects assigned to the following childrearing classes based upon a median-split technique: (*a*) high control-high nurturance—"overprotected"; (*b*) high control-low nurturance—"rejected"; (*c*) low control-high nurturance—"accepted"; and (*d*) low control-low nurturance—"ignored." To date these procedures have borne significant laboratory findings in relating perceived maternal childrearing to cognitive functioning (6, 8, 11, 13, 15, 17), level of aspiration (8, 12, 14), and personality (6, 12).

The findings of the cognition experiments are of special relevance to the present paper. Given socially reinforced cognitive tasks which are relatively susceptible to response interference, maternally rejected male offspring (6, 13, 15, 17) and female offspring (12, 13) were inferior performers. The experiment (8) in which the simplest cognitive tasks were employed found a reversal of the above; rejected females were among the superior performers. Interpretation of the experimental results has postulated an enhanced sensitivity to social reinforcers for high-control *S*s; in the special case of high control and low nurturance (rejection), however, this sensitivity is likely to take the form of associative interference in the face of socially aversive cues. Interfering responses, elicited by negative social reinforcement (real or imagined), are presumed to have been learned primarily in the context of the rejecting relationship with the mother and are presumed to consist of covert avoidance-withdrawal responses (18) and conditioned emotional responses (e.g., anxiety, hostility, shame, guilt).

Thus far in the series, the father has received research attention in only one experiment that used male offspring; and the child's concomitant perceptions of the father and mother have not been related to his behavior in any of the experiments that used male offspring. Heilbrun, Orr, and Harrell (15) report that paternally rejected males demonstrated the greatest cognitive disruption on a socially reinforced, concept-identification task; and accepted males demonstrated the least, with the difference being statistically significant. The results were essentially the same when males in a second sample were studied with the mother as the parental referent.

The first purpose of the present experiment was to determine the relationships between the female's cognitive proficiency under socially reinforced conditions and the perceived childrearing attributes of her father. The second purpose was to examine cognitive proficiency as it relates to the concomitant childrearing patterns attributed to the parents by the girl. To accomplish these objectives, the cognitive performance of 123 female *S*s, which had been previously related to perceived maternal childrearing behaviors (13), was analyzed using the father and father-mother combinations as the parental referents.

B. METHOD

1. *Subjects*

The 123 female *S*s were obtained from large undergraduate psychology classes at the University of Iowa.

2. *Childrearing Measures*

Perceived childrearing control of the father was assessed by the use of the paternal form of the PARI, recently developed by Schaefer and Bell [see (4)]. This questionnaire was administered with instructions to *S* to complete it as her father would. The paternal form includes 115 statements of childrearing attitude wherein *S* is provided the option of attributing strong or mild agreement or disagreement to the father. Four points are assigned to a "strongly agree" response down to one point for "strongly disagree." Cline, Richards, and Needham (4) report a factor analysis of the 23 paternal PARI scales in which a four-scale "authoritarian-control" factor was identified (fostering dependency, deception, deification, and exclusion of outside influences). Cumulative scores over the 20 items of these four scales were used to define perceived paternal control; the possible score range thus extended from 20 (low control) to 80 (high control). Of the four scales, three were among the eight that discriminated between the paternal attitude ratings of schizophrenics and normals (16). These four scales were used in one previous study of perceived paternal control (15).

Perceived maternal childrearing control was estimated from the daughter's ratings on the mother form of the PARI (22), which was administered to *S* with instructions to complete it as her mother would. An "authoritarian-control" factor, including 16 of the 23 scales, has been identified by two independent factor analyses (21, 26). Cumulative scores on 13[2] of these 16 scales have been employed in previous studies of the daughter's perception of maternal control (8, 9, 10, 11, 13, 14).

The second childrearing dimension, perceived paternal nurturance, was measured from *S*'s ratings upon the Parent-Child Interaction Rating Scales (7). *S* was asked to make eight ratings for each parent along five-point scales measuring various modes of parental nurturant behavior.[3] Ratings for each parent were then cumulated independently, thereby providing nurturance scores which could range from 8 (low) to 40 (high).

The crucial question of validity of these questionnaires has been discussed in some detail elsewhere (11). Since the validity issue for research instruments is probably best resolved by the ultimate fruitfulness of the research, it may suffice to point out that significant and theoretically meaningful results have been obtained in 15 studies and experiments in which one or more of these questionnaires has been employed.

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[2] Fostering dependency*, seclusion of mother, breaking the will, martyrdom, fear of harming the baby, excluding outside influence, deification*, suppression of aggression*, approval of activity, avoidance of communication, inconsiderateness of husband, suppression of sex, ascendance of mother, intrusiveness, acceleration of development, dependency of mother (scales followed by asterisk are not included in female control factor).

[3] Degree of felt affection, degree of physically-expressed affection, approval of *S*, acceptance of *S*'s personal feelings and experiences, concrete giving, positive encouragement, degree of trust, sense of security felt by *S*.

3. *Cognitive Task*

A version of the Stroop Color-Naming Test (24) was employed as the experimental task. The task material was a 12 × 16-inch piece of white cardboard upon which were printed 144 color words (e.g., "red"). Each word was printed in a different color from that designated by the word: for example, the word "brown" being printed in a blue color. Five different words and colors were used: red, brown, blue, green, and yellow. The words and colors were arranged so as to avoid any regularity of occurrence throughout the task. No word was printed in the color it named, but approximately an equal number of times in each of the other four colors. The 144 words were arranged in 12 lines of 12 words each.

S is instructed to name the color in which each word is printed. The task requires a mediating self-instructional set to avoid lapsing into the habituated reading response associated with the presentation of formal language symbols. Cognitive control, then, involves the maintenance of this set in opposition to both habitual reading responses and other task-interfering responses elicited by the socially aversive aspects of the experimental conditions. The less effective the control, the more likely that habitual reading responses (errors) would intrude in place of the task-relevant, color-naming responses (correct responses).

4. *Procedure*

*S*s were group administered the three questionnaires at which time they were informed that they were participating in an investigation of distraction with the eventual goal of determining whether males or females were less distractible (male *S*s were also run during this period for another study to make this bogus source of competition more believable than it would have been otherwise). Competition was also enhanced by offering a monetary reward for the best individual performance on the winning side.

*S*s were recalled in small groups (up to five) for the experimental session from one to four weeks after the questionnaires were administered. Each *S* was required to perform the color-naming task before *E* and the audience of other *S*s. Instructions stressed the avoidance of errors, but *S*s were also encouraged to respond as quickly as possible. *S* was further informed that each time she made an error *E* would say "wrong," and she would have to correct her response. After each *S* finished her turn, she returned to the audience and was replaced by another girl. Order of performance within each experimental group was left to vary unsystematically with childrearing pattern status which was unknown to *E*.

The experimental conditions were devised to include several potentially socially-aversive features. For one, *S* was required to perform a novel task before an audience of peers. For another, anticipated aversive consequences of failure were enhanced by the high incentives offered for successful performance (e.g., successful between-sex competition, peer approval, monetary reward). Finally, *S* was given negative social reinforcement upon making an error.

C. RESULTS

Perceived childrearing groups were defined by splitting the paternal and maternal control scores as near as possible to their respective medians; then each distribution of nurturance scores was divided as close as possible to its median within each high or low control group. These various cutting scores are given as footnotes to Tables 1 and 2.

An error was defined as any verbal response other than correctly naming the color in which the appropriate word was printed; errors included self-corrected responses as well as responses corrected by *E*. The error score distribution was positively skewed, so a square-root transformation of scores ($\sqrt{\text{score} + .5}$) was used to make the data amenable to parametric statistical analysis.

Mean error scores for the four perceived paternal childrearing groups are presented in Table 1. A two × two unweighted-means analysis of variance for unequal *N*s (25) was used to analyze differences among these means. The results indicated no main effect of control or nurturance but a highly significant ($F = 9.23$ for 1, 119 *df*; $p < .005$) control × nurturance interaction. Simple effects were then tested by *t* tests, using the within-cell mean square term (.83) from the analysis of variance in the error term for all comparisons. Two of these specific comparisons proved significant. Paternally rejected females were inferior to overprotected females ($t = 3.17$ for 57 *df*, $p < .01$) and to ignored females ($t = 2.61$ for 60 *df*, $p < .01$). The rank order of mean error scores among the four paternal childrearing groups was identical to that established when these girls were considered according to perceptions of their mothers (13).

The procedure chosen for analyzing the cognitive performance of girls as a function of the concomitant perceived paternal and maternal childrearing patterns was dictated to some extent by the large number of possible combinations and limited number of *S*s. It was decided to combine *S*s into three groups for each childrearing pattern: (*a*) both parents attributed the pattern, (*b*) mother attributed the pattern, father not, and (*c*) father attributed the pattern, mother not. This method of categorizing parental patterns, though crude, can at the least cast some light upon whether the presence or absence of a given childrearing pattern in the father contributes anything to the social aversiveness of the daughter beyond the effects presumably mediated by the mother. Table 2 gives the cognitive error scores of these parental childrearing pattern groups. Comparisons were made between the three error scores within

TABLE 1
STROOP COLOR-NAMING TEST MEAN ERROR SCORES FOR PERCEIVED PATERNAL CHILDREARING GROUPS

Perceived paternal childrearing group							
High control-high nurturance (overprotective)		High control-low nurturance (rejecting)		Low control-high nurturance (accepting)		Low control-low nurturance (ignoring)	
N	Mean[a]	*N*	Mean	*N*	Mean	*N*	Mean
31	2.27	31	2.87	33	2.55	28	2.14

Note: Cutting scores for paternal control were $\geqslant 43$ and low $\leqslant 42$. The high paternal nurturance cutting score for high control *S*s was $\geqslant 29$; and for low control *S*s $\geqslant 32$.

[a] Means based upon square-root transformations ($\sqrt{\text{score} + .5}$) of raw error scores.

TABLE 2
STROOP COLOR-NAMING TEST MEAN ERROR SCORES FOR PERCEIVED PARENTAL CHILDREARING GROUPS

	Parent combinations								
Perceived childrearing pattern	Both parents attributed pattern			Mother attributed pattern, father not			Father attributed pattern, mother not		
	N	Mean[a]	*SD*	*N*	Mean	*SD*	*N*	Mean	*SD*
Overprotecting	13	2.04	.59	16	3.28	1.20	18	2.44	.88
Rejecting	16	2.82	.50	15	2.26	.81	15	2.91	.76
Accepting	14	2.15	.86	15	2.52	.91	19	2.85	1.20
Ignoring	11	1.88	.88	23	2.47	.79	17	2.30	.96

Note: Cutting scores for maternal control were $\geqslant 147$ and low $\leqslant 146$. The high maternal nurturance cutting score for high control *S*s was $\geqslant 31$; and for low control *S*s $\geqslant 35$.

[a] Means based upon square-root transformations ($\sqrt{\text{score} + .5}$) of raw error scores.

each childrearing category by means of individual t tests, and five of the 12 tests proved statistically significant (Table 3). Thus, despite the congruence between the earlier mother-daughter and the present father-daughter findings, joint consideration of both parents did contribute some knowledge about perceived childrearing behavior and daughter's cognitive proficiency under socially aversive conditions beyond that generated by studying either parent alone.

TABLE 3
STATISTICALLY SIGNIFICANT DIFFERENCES IN STROOP ERROR SCORES AMONG FEMALES WITH VARYING PARENTAL CHILDREARING COMBINATIONS

	Both mother and father attributed pattern (I) *versus* mother attributed pattern but father not (II)				Mother attributed pattern but father not (II) *versus* father attributed pattern but mother not (III)			
Perceived childrearing pattern	t	df	p	Direction of difference	t	df	p	Direction of difference
Overprotecting	3.35	27	.01	(I) < (II)	2.33	32	.05	(II) > (III)
Rejecting	2.24	29	.05	(I) > (II)	2.17	28	.05	(II) < (III)
Ignoring	2.03	32	.05	(I) < (II)				

Note: No significant differences were obtained for the third possible set of comparisons (i.e., both "mother-and-father-attributed-pattern" groups *versus* "father-attributed-pattern-but-mother-not" groups). However, a t value of 1.84 ($p < .07$) resulted when these groups were compared using the "accepting" pattern data (see Table 2).

D. DISCUSSION

Just as earlier research indicated the same relationships to hold between the son's perceptions of his mother's and his father's childrearing control-nurturance behaviors and his ability to conceptualize under socially reinforced conditions, the present results suggest the same order of relationships between the daughter's perception of each parent and her cognitive effectiveness when exposed to social evaluation. It can now be stated with some confidence that rejecting tendencies in either parent tend to be associated with cognitive impairment in either sons or daughters if the cognitive activity holds some degree of complexity and is socially reinforced.

To briefly summarize prior reasoning regarding parental rejection, the child who has experienced the parent as controlling and hostile has been frequently placed in the position of being critically evaluated by this reinforcing agent. This interpersonal situation thwarts both the development of the child's ability to transact competently with his social and physical environment, as well as the child's subjective sense of competence. This combination greatly reduces the child's range of adaptive responses to parental criticism, since he is not likely to behave competently enough to obviate the censure nor to have the sense of personal competence necessary to disregard it. One primitive adaptive response to aversive parental reaction left to the child is the avoidance or withdrawal response. Later, covert avoidance-withdrawal responses, in combination with the conditioned emotional correlates of negative parental reinforcement, may serve to interfere with task-relevant cognitive activity if they are elicited by social-reinforcement conditions. The degree of cognitive interference generated by social reinforcement will be a function of the level of arousal of the generalized responses and the susceptibility of the cognitive activity to interference.

The term "rejection," as applied to parent behavior, has been given a rather special meaning in our research, since it has combined the perceived qualities of both low nurturance (the usual defining attribute) and high control. The usefulness of differentiating rejection from ignoring, which also involves low perceived nurturance, has become clear when the daughter's response to social reinforcers is studied. In contrast to the sensitivity of the rejected girl, which displays itself in both motivational arousal and associative interference, the ignored daughter appears to be relatively unresponsive to social reinforcers. When the ignored girl's motivational level is raised by multiple incentives and the task is susceptible to interference, as in the present experiment, she clearly outperforms the rejected girl. If incentives are less and the task is simple, the performance difference between these two groups is reversed (8).

The rank order of cognitive proficiency for the groups in this experiment, which were defined by the perceived childrearing attributes of the father, was the same found when the mother's childrearing behavior was the basis for group assignment (8): namely, ignored (best), overprotected, accepted, and rejected (poorest). The parallel results could be regarded as strong confirmation of this ordered array of contingencies between perceived parent behavior and cognitive control of the daughter. The question could be raised, however, as to whether the childrearing attributes of the two parents described by the same girl are sufficiently unrelated to consider the father data as independent evidence. For example, 44 per cent of the parent pairs were attributed the same childrearing pattern where only 25 per cent would be expected by chance. Fortunately, the analysis of cognitive performance in terms of joint parent patterns revealed clearly that the perceived qualities of the father allow predictions that differ from those generated from the qualities of the mother. The clearest example is in the realm of parental rejection. Whereas perceived rejection by the father was associated with poorer cognitive control whether the mother was rejecting or not, similar rejection by the mother alone was not. Thus, perceived rejection by the father emerges as having a greater subsequent influence upon cognitive effectiveness for the daughter than does perceived maternal rejection.

The opposite case can be made when considering parental overprotection. The occurrence of this pattern in the father was positively related to the daughter's cognitive functioning; however, given maternal overprotection alone, female offspring were very poor performers. Since the mother's close relationship with the daughter is often assumed to be of crucial importance in her social development, the joint parent findings discussed to this point are rather surprising. It is rejection by the father and not the mother that appears to be conducive to social aversiveness; similarly, it is overprotection by the mother and not the father that is associated with cognitive disruption, given the social stressors used in this experiment. At the least, these findings should encourage developmental and clinical theorists to attend more to the role played by the father in the social development of the daughter.

E. Summary

The perceived control and nurturance childrearing behaviors of the father alone and of the father and mother in combination were related to the cognitive control of the daughter under conditions of social stress. The paternal findings for 123 college females indicated that low control-low nurturance (ignored) *S*s performed best and high control-low nurturance (rejected) *S*s performed most poorly, replicating earlier findings using perceptions of the mother.

When the perceived father and mother childrearing patterns were considered in combination as they related to cognitive performance, the results indicated the greatest disruptive influence of rejection by the father and overprotection (high control-high nurturance) by the mother.

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PAIRED ASSOCIATES LEARNING AS A FUNCTION OF AGE, RATE, AND INSTRUCTIONS*

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A. INTRODUCTION

Although studies of learning as a function of aging have indicated that old *S*s require more trials (6) and make more errors (3, 5, 7) than young *S*s, studies of rate of presentation (or stimulus duration) have suggested that a large portion of the age-related deficit can be accounted for on the basis of the available time for a response (3, 5). Performance, especially as reflected by omission errors, is poorest for aged *S*s at fast rates and improves significantly as rate decreases. On the other hand, it has been further suggested that the large differences in omission errors at the fast rates may not only be a function of insufficient time to respond, but may also be related to the fact that old persons appear to be more reticent about responding than young persons (4, 7). The purpose of the present experiment was to determine if the requirement and encouragement to respond would reduce omission errors and produce an improvement in performance of old *S*s.

B. METHOD

1. *Apparatus and Procedure*

A paired associates learning task was employed, and the pairs were the following CVC trigrams: FAM-TIR, CUS-JAZ, PIL-DOV, and GOB-KEN. These pairs were chosen to provide a high level of meaningfulness for each trigram (1), and a low similarity of letters within and among the pairs. Using the norms devised by Archer (1), the mean meaningfulness of the four stimulus trigrams (S) was 91 per cent and the mean meaningfulness of the response members (R) of the pairs was 88 per cent. A total of 30 trials was devised and eight different random orders were used for the four pairs of syllables. The 30 trials were typed onto a belt of paper and presented by a Lafayette Memory Drum. An asterisk indicated that a trial had been com-

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pleted, while a second asterisk indicated that the next trial was about to begin. Four groups of young and old *S*s performed, with one in each of four rate-of-presentation by response-instruction combinations. The two presentation rates were four seconds (i.e., four seconds for S and four seconds for the S-R pair), and eight seconds (i.e., eight seconds for S and eight seconds for the S-R pair). The two response instruction groups that performed in combination with each of the two rates are designated as the No Response Group and the Required Response Group. The *S*s in the No Response Groups were given the general instructions for the usual paired associates task and were told that their job was to attempt to respond to the first syllable of each pair before both syllables in the pair were presented together. The *S*s in the Required Response Groups were given the identical instructions and further told that a response was required for each stimulus presentation and that, if the correct answer was not known, a best guess must be provided. Although *E* provided encouragement for both groups during the task, the Required Response Groups were further reminded at the end of each trial that a response should be given each time a stimulus appeared.

All *S*s in all groups were tested individually. Prior to initiation of the task, a practice trial with the use of paired names was given to insure that instructions were understood. During the first presentation of the actual S-R trigrams, all *S*s were required to view and rehearse each pair, while the second presentation of the pairs was designated as Trial 1. The criterion for completion of the learning task was two errorless trials in succession within a maximum limit of 30 trials.

2. *Subjects*

The *S*s consisted of 40 persons ranging in age from 61 to 83 years with a mean age of 69.7, and 40 persons ranging in age from 20 to 35 years with a mean age of 26.1 years. Within each of the two age levels, the *S*s were equated so that the mean ages for the four experimental conditions were between 68.7 and 71.3 years for the old groups, and between 25.0 and 27.0 years for the young groups. The groups were further equated with respect to the Wechsler Vocabulary subtest (8), so that the mean weighted vocabulary scores ranged from 12.6 to 13.1 for the old groups, and 12.7 to 13.1 for the young groups. Analyses of variance indicated that there were no significant differences for the vocabulary scores and further that the experimental subgroups were similar with respect to age.

The eight males and 32 females within each of the two age levels volunteered for participation without payment. The *S*s in the aged group were all members of various senior citizen clubs in Syracuse, New York, while the young *S*s were employees from the Syracuse VA Hospital and other local medical centers. In order to achieve the goal of 40 *S*s in the old age group, a total of 52 *S*s were utilized. Five of the additional 12 *S*s did not learn to criterion, while the remainder quit the task after performing on the initial trials.

C. RESULTS

An analysis of variance of the total number of omission errors indicated that the main effects of age ($F_{1,\,72} = 36.94$, $p < .01$), rate of presentation ($F_{1,\,72} = 15.33$, $p < .01$), and the interaction of age with rate ($F_{1,\,72} = 9.02$, $p < .01$) were the only significant sources of variance. Tests of the simple main effects within the age × rate interaction indicated that the old *S*s made significantly fewer errors with eight seconds than with four seconds ($F_{1,\,72} = 8.85$, $p < .01$), while there was no difference between these rates for the young *S*s. Further, the simple effect comparisons across age groups indicated that the old *S*s made significantly more omission errors than the young *S*s at the four-second rate ($F_{1,\,72} = 15.25$, $p < .01$), but the difference between the two age groups was not significant at the eight-second rate. Table 1, a summary of the mean error scores for age and rate, clearly shows the data underlying the above effects.

TABLE 1
MEAN TOTAL COMMISSION AND OMISSION ERRORS AS A FUNCTION OF AGE GROUPS AND RATE OF PRESENTATION

Type of errors	Age	4 sec.	8 sec.	Age group means
Omission	Young	1.50	0.55	1.02
	Old	10.95	3.75	7.35
Commission	Young	2.65	0.85	1.75
	Old	6.65	3.60	5.12

The analysis of variance of the commission errors indicated that the only significant sources of variance were the main effects of age ($F_{1,\,72} = 13.78$, $p < .01$) and rate of presentation ($F_{1,\,72} = 7.12$, $p < .01$). As with omission errors, response instructions had no effect upon commission errors either alone or in combination with the other variables. Table 1 shows the mean error scores that underlie the significant effects and indicates that aged *S*s made more commission errors than young *S*s, while both groups made fewer errors as rate of presentation was decreased.

Figure 1 presents a comparison of the mean omission and commission errors per trial for the old group of *S*s for the first 10 trials. Since the No Response and Required Response groups had similar trends, they were combined, and each point represents a mean over 20 *S*s. Aside from clearly showing that omission and commission errors decreased with rate, Figure 1 further indicates that at both rates commission errors remained fairly constant, while omission errors decreased markedly in the early trials. The major differences in relative omission and commissions at the two rates were that at eight seconds omissions had decreased to the level of commissions by the second trial, while at

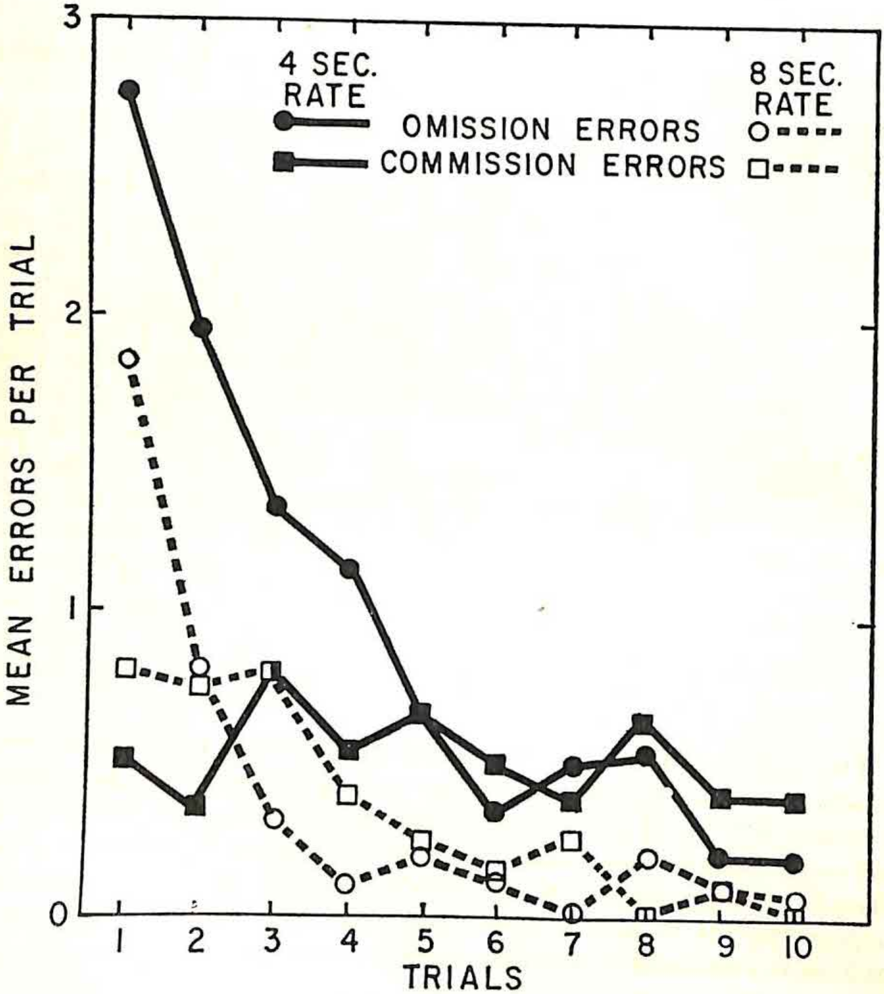

FIGURE 1
MEAN OMISSION AND COMMISSION ERRORS PER TRIAL FOR THE OLD GROUPS AS A FUNCTION OF RATE OF PRESENTATION

the four-second rate this did not occur until the fifth trial. A similar set of comparisons for the young *S*s indicated that more commission than omission errors were made at all trials.

D. DISCUSSION

In general, the results for rate of subject-pacing and age groups are in agreement with the previous findings in the literature (3, 4, 5). As in previous studies, the results suggest that as rate of subject-pacing decreases, performance of old *S*s approaches that of young. Further, old *S*s had a larger decrease of omission errors than commission errors as rate decreased than did young *S*s.

The failure of the response instruction groups to produce any differences in the number of omission and commission errors agrees with the suggestion that old people have a marked tendency to withhold responses (4, 7). Further, the finding that at both rates omission errors decreased sharply as a function of trials without any corresponding increase in commission errors indicates that, in general, omission errors by the old groups were being replaced by correct responses. This suggests that the older *S*s did not respond unless there was confidence that a response had a high probability of being correct. Even at the eight-second rate, with a sufficient time to respond and with encouragement and a requirement to respond (i.e., Required Response Group), the old *S*s apparently preferred to omit answers on the first trial rather than possibly make additional commission errors. On the other hand, the finding that omission and commission errors were equal for both response groups on the second trial at the eight-second rate suggests that the tendency not to respond can be rapidly overcome if there is sufficient time to rehearse and respond to the material. The corresponding results at four seconds suggest that, as time for rehearsal and response decreases, it takes more trials before old *S*s can respond both quickly and confidently.

The suggestion that old *S*s use omissions as a means of defense by withdrawal (4, 7), and therefore may require a higher degree of confidence before responding (2, 4), is consistent with the present findings, but would not be sufficient as an explanation until studies are performed to determine actual rehearsal time required by old *S*s. That is, although the present experiment suggests that old *S*s require a high degree of confidence before responding, the high rate of omission errors may be due to the fact that aged *S*s may require more time to rehearse and learn the materials before attaining the same level of confidence as young people. Although the studies of Eisdorfer (4) and Canestrari (3) clearly indicate that actual response time is an important factor in evaluating age-related decrements, there has been no research to date that has separated the time required for a response from the time required for rehearsal of the materials. Studies of rehearsal time could be performed in a paired associates task by independently varying the stimulus duration (response time) and the stimulus-response pair duration (rehearsal or learning time).

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SELF-SOCIAL CORRELATES OF ORIGINALITY IN CHILDREN*[1]

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A. INTRODUCTION

Originality, which Guilford (6) identified as one aspect of divergent thinking, is usually considered a favorable cognitive trait. One criterion for defining originality, however, is the unusualness of a response (2, 7, 23). The person who is highly original may thus, by definition, be described as nonconforming. This point of view is supported by Barron's (2) finding that individuals rated high in originality also demonstrate high independence in the Asch conformity experiment.

Studies of social interaction have shown that when a person deviates from the opinion or behavior of a group, there is a tendency for the group to reject him (4, 18). In Schachter's study, for example, the deviant received significantly fewer sociometric choices, nominations for desirable offices, and communications (after an initial increase in communications). The nonconformity of the highly original person may thus lead to a relatively high proportion of negative social experiences.

Tumin (26) has discussed this phenomenon and believes these negative social forces to be obstacles to creativity. Roe (17), also, when discussing the personal problems of scientists from a developmental standpoint, mentions the social difficulties of the child who is different. Torrance (23) has observed the social conflicts resulting from the free expression of ideas, and describes the psychological estrangement of the creative child. He believes (24, p. 39) that it is "almost inevitable" that creative individuals alienate peers. Getzels and Jackson (5) found the high-creative child less popular with teachers than the high-*IQ* child. These studies indicate some of the difficulties experienced by persons who are highly original.

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A self-social theory of personality assumes that social experiences affect and, indeed, largely determine a person's self-concept (1, 9, 14, 19). Thus, the particular social experiences associated with originality would be expected to influence an individual's definition of himself. Specifically, it is thought that the social rejection experienced by the highly original child will lead to a perception of the self that is relatively negative and alienated from others. The present study has investigated this hypothesis among a population of fifth- and sixth-grade children high and low in originality. Specific predictions are presented below.

B. METHOD

Most previous investigations of the self-concept in relation to originality have employed adult subjects [(2, 13), for example]. While the use of adult subjects makes it possible to base a definition of originality upon concrete evidence of performance (i.e., professional success), such studies provide only indirect evidence about the effects of childhood experiences. Since the assumed social rejection for the highly original person would presumably occur in childhood, as well as later, and since early experiences and perceptions are deemed important in personality development, a study of the self-concept of children in relation to originality was indicated.

In the measurement of the self-concept of children, nonverbal methods have a number of advantages; i.e., their low visibility avoids socially desirable responses, and their low verbal demands prevent the confounding of results by such factors as verbal ability and the idiosyncratic meaning of words. For these reasons a preponderance of nonverbal measures was used in this study.

Wylie (27) suggested that the self-referent constructs of much of research related to the self-concept are overgeneralized, and that use of molecular-type variables may provide improved research utility. Accordingly, the present study has focused upon the following aspects of the self: individuation; esteem; power in relation to father and teacher; identification with friend, mother, father, and teacher; dependency; and complexity. Specific predictions and operational definitions of these components of the self are described below.

1. *Subjects and Design*

Torrance's Parallel Lines Test (25), a nonverbal test designed to measure various aspects of divergent thinking, was administered to all—111—pupils in the fifth and sixth grades of an elementary school. These students were white, and varied widely in intelligence, academic achievement, and social class. All resided in a semirural community in Maryland. A sociometric task, requiring each child to choose a companion for five activities (play on the playground, make a puppet theater, go on a picnic, play at home, work on a science project), was also administered.

In the Parallel Lines Test, children are allowed 10 minutes to draw as many pictures as possible from 30 pairs of lines, and are then asked to label each drawing. These tests were scored for originality according to Torrance's norms. (The score for originality is based upon the unusualness of the object drawn.) On the basis of these scores, the 15 highest boys and the 15 highest girls were selected to form the "original" group. The 15 lowest boys and 15 lowest girls comprised the "nonoriginal" group. The experimental tasks (described below) were administered to these 60 subjects. Because sex and grade effects for these tasks had been investigated in an earlier study (12), boys and girls from both grades were pooled and comparisons made only between the "original" and "nonoriginal" groups. Otis *IQ*s and scores from the Iowa Tests of Basic Skills were also available for these subjects.

2. *Experimental Tasks*

The experimental tasks consisted of the Children's Self and Social Constructs Test (12) and the Self-Complexity Index (28).

The Children's Self and Social Constructs Test is designed to measure various aspects of the self in relation to salient other people. The test is administered to the subjects in groups, and all instructions are oral, all responses nonverbal. Scores are provided for (*a*) individuation; (*b*) esteem; (*c*) power in relation to father and teacher; (*d*) identification with friend, father, mother, and teacher; and (*e*) dependency. Test-retest reliability coefficients (over a period of one week) among a sample of 62 fourth, fifth, and sixth graders ranged from +.26 to +.87 with a median of +.49. Internal consistency reliability coefficients among a sample of 81 fifth graders ranged from +.78 to +.94. A brief description of each measure, and hypotheses, relating each to originality, follow.

a. Individuation. Individuation of the self is assumed to be the degree to which the person differentiates himself from his peers. This measure consists of the choice of a symbol (circle) to represent the self that is "like" or "different from" symbols representing peers. A greater degree of individuation is assumed to be evidenced by the choice of the "different" circle. The validity of this task is supported by the finding that 27 pairs of twins represented themselves significantly ($p = .05$) more often as "like" than did nontwin controls matched for sex, age, and class in school. Previous research revealed that individuation increased with age in elementary school (12). Eighth-grade students who had moved frequently were also found to demonstrate significantly higher scores on this measure than those who had lived all their lives in a single community (28). Because the "original" child often occupies a deviant position, a positive relationship between individuation and originality was hypothesized. This prediction is in harmony with Stein's (20) finding that highly creative adult subjects perceived the self as "different."

b. Self-esteem. Self-esteem was defined as the value or importance attributed to the self in comparison with others. In this task, subjects were presented with an horizontal array of circles representing peers and asked to select one circle to represent the self. In harmony with a cultural norm, positions to the left were assumed to be associated with higher esteem than were positions to the right. Evidence for the validity of this task was found in an earlier study (8) in which 96 elementary school children placed the "smartest" child in the class to the left and the "dumbest" and "bad" child to the right to a significant degree ($p = .001$). A sample of 48 children also placed the self significantly ($p = .02$) farther left among a group of peers than among a group of adults (in a separate item). The findings that neuropsychiatric patients placed the self significantly farther to the right than normals (30) and that sociometric isolates placed the self significantly farther right than sociometric stars (29) also support the validity of this task. The social rejection assumed to be experienced by the "original" child was expected to produce a lower self-esteem in this task. A negative relationship between self-esteem and originality was thus hypothesized.

c. Power. Power of the self was assumed to be the conception of the self as superior, equal, or inferior to particular other persons. In the power tasks the child is asked to choose a circle to represent another person (father or teacher in this study) from among circles which are (*a*) directly above, (*b*) diagonally above, (*c*) even with, (*d*) diagonally below, or (*e*) directly below a circle representing the self. Placement of the other person in a lower position than the self was assumed to indicate more power for the self than for the other person. Evidence for the validity of this task was found in an earlier study in which three samples of eighth graders ($Ns = 83, 60, 76$, respectively) placed "teacher" in a significantly ($p = .01$ or less in all cases) higher position than they placed "friend," in a separate item (28). In relation to originality, the nonconformity of the "original" child was assumed to involve a certain defiance of authority figures. Less power for father and teacher, more power for the self, were thus hypothesized as a correlate of originality.

d. Identification. Identification of the self with particular other people (mother, father, teacher, friend in this study) is assumed to be the placement of the self in a "we" category with the other person (15). Physical distance is assumed to represent psychological distance, and less distance between the self and the other is interpreted as greater identification.

In one identification task, the subject was presented with a row of circles with another person (mother, father, teacher) located on the circle to the extreme left. The subject was asked to select one of the remaining circles to represent himself.

Evidence supporting the validity of this item was found in a recently completed study. First-grade children separated from their natural fathers were found to place the self significantly farther from father ($p = .02$) than children of the same age and socioeconomic class whose natural fathers were present in the home. A second finding was that children rated by their teachers as "shy with teacher" placed the self significantly farther from teacher ($p = .05$) than did those rated as "friendly with teacher" (11).

In a second kind of task, the subject was presented with two gummed circles (one for self, one for friend) and instructed to paste them on a blank sheet of paper in any way he chose. The distance between the circles was measured in centimeters. In the first task, distance was the number of circles intervening between the self and other. Earlier research had demonstrated that girls of elementary school age placed the self significantly closer to mother and female teacher than did boys ($p = .005$ for mother; $p = .05$ for teacher). With an increase in age in elementary school, distance between self and friend decreased ($p = .01$) and distance between self and teacher increased ($p = .01$) (12).

Again because of the social rejection for the "original" child, less identification with parents, teachers, and friends was hypothesized. This prediction is in harmony with Stein's (20) finding that creative adults see themselves as distant from their parents.

e. Dependency. Dependency of the self was assumed to be the degree to which the child perceives the self as belonging to a social group comprised of parents, teachers, and friends. In this task, circles representing these three categories of people were placed at the apexes of an equilateral triangle. The subject was given a gummed circle to represent the self and asked to paste it on the paper with the other people, only not on top of any. Location of the self within rather than without the triangle of other people was assumed to reflect a higher degree of dependency. Evidence for the validity of this measure was found in a previous study (12) in which elementary school children who placed the self within the triangle were found to prefer group, as opposed to individual, activities to a significant degree ($p = .01$). Because of the nonconformity of the "original" child, a negative relationship between dependency and originality was hypothesized.

f. The Self-Complexity Index. The Self-Complexity Index, an adjective checklist composed of 110 high-frequency adjectives from the Thorndike Lorge Word Book (22), was a second experimental task (28). Subjects on this task are instructed to check those adjectives that are descriptive of the self. The number of adjectives checked was assumed to provide a measure of the complexity of the self. Evidence for the validity of this assumption was derived from a study in which a significant positive relationship was found between self-ratings of complexity and the number of adjectives checked (16). A significantly positive relationship was also found between the number of adjectives checked and the number of words written about the self in a situation in which a limited amount of time was allowed to write about both self and friend (28). A test-retest reliability over a period of two weeks of .89 was found for this measure (16). In accordance with Barron's (2) findings, greater complexity of self was hypothesized as a correlate of originality. In addition to a measure of self-complexity, the adjective checklist provided a verbal self-description supplementing information from the nonverbal measure.

C. RESULTS

1. *Popularity,* IQ, *and Achievement*

The "original" group was less popular than the "nonoriginal" ($\bar{x} = 5.0$ for the original; $\bar{x} = 6.3$ for the nonoriginal), but this difference did not attain statistical significance ($t = 1.00$, n.s.). The two groups were also not significantly different in *IQ* or in the composite scores from the Iowa Test of Basic Skills, although the means were higher in both tests for the "original" group (*IQ*: $\bar{x} = 114$ for the originals; $\bar{x} = 109$ for the nonoriginals; Iowa Tests of Basic Skills, composite score: 75.5 mean percentile for the originals; 67.1 mean percentile for the nonoriginals). A significant interaction was found between originality, and reading, and arithmetic scores from the Iowa Test ($p = .01$). For the "original" group, reading scores were higher than arithmetic scores, while the opposite was true for the "nonoriginal" group (10).

2. *Self and Social Constructs*

Significant differences ($p = .05$ or less) were found between the "original" and "nonoriginal" groups on the following measures:

a. Self-esteem. As hypothesized, the self-esteem of the "original" group was significantly lower than that of the "nonoriginal" ($\bar{x} = 3.1$ for the original; $\bar{x} = 4.6$ for the nonoriginal; $t = 2.73$, $p =$ about .01).

b. Power. Mean scores for power in relation to teacher or father did not differentiate the two groups. It was noted, however, that the "nonoriginal" group tended to place the other person (father, teacher) in the diagonal or even position, in contrast to the "original" group, who tended to make more use of the extreme positions (either directly above or directly below the self). In order to investigate this effect, these tasks were rescored, with a score of one assigned to either diagonal or even position, and a score of zero to either extreme position. When scores were summed from the tasks related to father and teacher, it was found that the scores of the "nonoriginal" group were significantly higher ($\bar{x} = .8$ for the original; $\bar{x} = 1.2$ for the nonoriginal; $t = 2.47$, $p = .02$).

c. Identification with mother and father. No significant difference in mean scores was found for identification with mother or father. It was noted, however, that the "original" group tended to place the self closer to the opposite-sex parent than to the same-sex parent, while the reverse was true for the "nonoriginal" group. To investigate this effect, subjects were categorized as (*a*) placing the self closer to same-sex parent than to opposite-sex parent, (*b*) placing the self closer to opposite-sex parent than to same-sex parent, (*c*) placing the self equidistant from both parents. Although the majority of subjects in both groups fell into category (*c*), the categorization of the 24 subjects who differentiated between their parents was significantly related to their originality status. (Original group: 10 per cent (*a*); 30 per cent (*b*); 60 per cent (*c*); Nonoriginal group: 30 per cent (*a*); 10 per cent (*b*); 60 per cent (*c*); $\chi^2 = 6.0$, $df = 2$, $p = .05$.)

d. Dependency. Contrary to the initial hypothesis, the "original" group was found to be significantly more dependent than the "nonoriginal." (Original: 87 per cent inside the triangle; nonoriginal: 60 per cent inside the triangle; $\chi^2 = 5.46$, $df = 1$, $p = .02$.)[2]

e. Other measures. No significant differences were found between the "original" and "nonoriginal" groups on the measures of (*a*) individuation, and (*b*) identification with teacher, or (*c*) friend from the Children's Self-Social Constructs Test, nor in the number of adjectives checked on the Self-Complexity Index.

f. Adjectives. An item analysis of the adjectives checked as descriptive of self differentiated the two groups as follows: (*a*) adjectives checked significantly more often by "originals": .05 level—active, miserable, sad, unhappy; .10 level—clever, wild; (*b*) adjectives checked more often by "nonoriginals": .05 level—useful, weak, charming; .10 level—little.

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[2] This finding and the one related to greater affinity for opposite-sex parents was replicated ($p = .01$ for dependence; $p = .05$ for parents) among a sample of 54 high-achieving fifth graders (mean $IQ = 122.1$), selected for their high or low scores on Torrance's Lines Test. Among these high achievers, esteem scores were not found to be lower among the "original" group, nor were they found to have more authoritarian attitudes to teacher and father.

D. DISCUSSION

The present study is limited due to the fact that the sample is small and that the criterion for originality is a single test. Within these limitations, however, the findings support the view that the person high in originality is characterized by particular perceptions of self-other relationships. In responding to the power tasks, the "nonoriginal" group tended to place father or teacher either even or diagonal to self, while the "original" group tended to place these persons either directly above or below the self. The greater use of the horizontal positions by the nonoriginals seems to suggest a more egalitarian relationship to authority figures, which may indicate a greater acceptance of authority.

The placement of father or teacher directly below the self (which appeared among 13 of the "originals" and only three of the "nonoriginals") was of particular interest, since it suggests a certain degree of derogation for teacher or father. Such derogation may be one aspect of the nonconformity of children high in originality.

Among the 24 children in the sample who differentiated between their parents on the identification measures, nine out of the 12 from the "original" group placed the self closer to the opposite-sex parent. The reverse was true for the "nonoriginal" group (nine out of 12 were closer to same-sex parents). This finding, although derived from a small sample, is of interest because it supports Barron's (2, p. 221) suggestion that cross-sex identification may be important for creativity, and Drevdahl's (3) finding that highly creative adult males report a stronger attachment in childhood to mother than to father.

Greater identification with opposite-sex parents by children high in originality also adds meaning to a frequently reported finding of relatively high degree of femininity among creative males [(13, 21), for example]. Torrance (23, p. 112) summarizes evidence that high-creative girls appear more masculine and high-creative boys more feminine than the average child. This failure to adopt conventional sex roles, which may be yet another aspect of the nonconformity of the high-original person, may be derived from an early identification with the opposite-sex parent. Further research is indicated to investigate this possibility and to discover some of the underlying reasons, as parental behaviors or attitudes, for this effect.

The findings of greater dependency and less esteem among the "original" group appear related, since a significant negative relationship between these two measures ($r = -.37$, $N = 84$, $p = .01$) (12) was found in an earlier study.[3] Both measures had also been found to differentiate sociometric stars from isolates, with the isolates, like the "originals" in this study, showing less esteem and greater dependency (29). The finding of lower esteem for the "original" group than for the "nonoriginal" group in this study supports the hypothesis and suggests that the social rejection experienced by the "original" child results in a relatively negative self-concept. These negative self-attitudes are particularly striking in view of the relatively successful achievement of the "original" child in this sample.

Evidence in relation to conscious aspects of the self-concept is supplied by an item analysis of the Self-Complexity Index. The constellation of traits that distinguish the "nonoriginal" group—weak, charming, useful, and little—appears to reflect the low ego strength (2) and conformity of the child low in originality. These adjectives form a striking contrast to those chosen by the "original" group—active, miserable, sad, unhappy, wild, and clever. From this group, the adjectives "active," "clever," and "wild" seem to express the high energy, ingenuity, and nonconformity of the "originals," while the "miserable," "sad," and "unhappy" group may reflect the social conflicts of these children.

It was noted, however, that 40 per cent of the "original" group (as compared to 10 per cent of the "nonoriginal") reported themselves as both "happy" and "unhappy." This response suggests the many-sided viewpoint of the "original" child, and also seems to be an honest response, since the conventional, socially desirable response would presumably be "happy."

In summary, within the limitations of sample and criterion for originality, the present study provides additional evidence that persons high in originality are characterized by particular self and social attitudes. Less identification with same-sex parent and a more authoritarian relationship with father and teacher suggest that the highly original child is somewhat alienated from these salient adults. The findings of lower esteem, greater dependency, and greater unhappiness suggest that the social rejection accorded the child high in originality has generalized to his conception of himself.

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[3] A converse relationship ($r = +.40$) was found in a later study of 81 high achieving fifth graders, indicating perhaps that highly successful achievement in school may be related to a self-concept in which dependency, as measured here, can be interpreted as a more positive "social interest" rather than affiliation derived from feelings of inferiority or fear of rejection.

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DECENTRATION IN THE DEVELOPMENT OF CHILDREN'S CONCEPTS OF MORAL AND CAUSAL JUDGMENT*[1]

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A. INTRODUCTION

Piaget suggested a series of developmental stages leading to maturity in the areas of moral judgment (9), causal judgment (5, 6), and general reasoning (7, 8). Common to these areas of judgment are three general stages of conceptual development. The first is a stage of sensori-motor intelligence (ages zero-2) during which the infant moves from an organizational pattern of undifferentiated responses to a pattern of increasingly complex, specific responses. "The organization is an entirely 'practical' one, however, in the sense that it involves simple perceptual and motor adjustments to things rather than symbolic manipulations of them" (3, p. 86). The second stage begins with the first formation of symbols for objects (age 2) and concludes with a fairly rational understanding of the organization of objects in the surrounding world (age 11). The child acquires a sense of the relations among objects, although this understanding is confined to a concrete level. During the third stage (ages 11-15), the child develops the capacity for logical thought. Object relationships can be understood in terms of their formal properties and the child can construe the world in less immediate, propositional terms. Each of these stages can then be further subdivided into two phases: the earlier phase is dominated by a state of "egocentrism" or the "failure to differentiate between the ego and the group, or confusion of the individual point of view with that of others" (6, p. 384); the later phase is dominated by a reorientation in which the child relates objects "to his own viewpoint . . . distinguishing it from other viewpoints" (11, p. 210).

The movement from ego-centered to object-relevant judgment can be illustrated by a change in the development of causal judgment. During the egocentric phase of the stage of concrete operations (the stage of precausal thought), children believe that night falls so that they can sleep, rain falls to

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water the flowers, or dream images have objective reality and can be seen by others. These judgments represent a projection of individual perspective onto the physical world. During the object-relevant phase of this stage, children come to the realization that natural events have explanations based upon physical principles; and judgments about them are based upon the objective properties of the events rather than upon a projection of personal perspective. In passing from precausal to causal operations, the child must pass from an overreliance upon subjectivity to a dependence upon objective judgment.

Just the reverse of this process must occur to enable the child to move toward mature moral judgment. During the first stage of moral judgment, "moral realism" (ages 2-9), judgments are absolute, independent of intent and context, and are physicalistic. They are immutable and are based upon objective outcome. For example, the child who breaks one cup while taking forbidden jam is judged less naughty than the child who breaks 15 cups while trying to comply with his parents' wishes. During the second developmental stage, the "morality of equity" develops (ages 9-15); and moral judgments are based upon social principles with recognition of context and intent. Judgments are more flexible than during the first stage and are geared to preservation of the equalitarian rights of others. Rules are therefore respected not merely because they exist, but because of their social function: they are transformed from mystical authoritarian commands into internal principles. In passing from moral realism to the morality of equity, the child must pass from an over-objectivity to the capacity for subjective evaluations.

Piaget suggests that the mechanism of transition from one stage to the next, and from earlier to later phases within stages, is the process of decentration or "the ability to shift the given cognitive perspective" (10, p. 3). Decentration is similar to the "reasonable reorganization" hypotheses of Gestalt psychologists. Wertheimer, for example, refers to "reorientation which enables the subject to view the given situation in a new and more penetrating perspective" (16, p. 170). Thus it is decentration that enables children to move from subjective to objective causal judgments, and from objective to subjective moral judgments.

B. HYPOTHESES

If decentration is a necessary precondition for the acquisition of mature judgment, then all children capable of mature moral and causal judgments should also be capable of decentration. Accordingly, it is hypothesized that, while some decentrating children may not be mature in moral and causal judgment, all children who are mature in these areas will also be decentraters.

While Piaget has generated a stage-mediated theory of development, rather than an age-mediated theory, many of his critics (3) evaluate the validity of his contribution by contradicting age-norms for the acquisition of varied cognitive capacities. Indeed, when Piaget does refer to age, he is careful to note that mental age is the chief variable (8, p. 81). In order to establish the centrality of decentration, it must be shown that this ability is a stronger predictor of cognitive maturity than age or mental age. Accordingly, it is hypothesized that, while decentration may be related to age, with age controlled, decentration will account for significant differences in the maturity of judgment.

C. METHOD

1. *Research Plan*

The goal of this research was to explore the importance of decentration as a force in children's cognitive development. Both moral and causal judgment abilities were studied, in relation to the capacity for decentration. A single instrument was developed in which factorially independent measures of each of these abilities were demonstrated, and it was administered to elementary school children in individual interviews. The three sections of the instrument were scored so that three dichotomous groups of children could be identified: high and low decentraters, mature and immature moral judges, and mature and immature causal judges. It was then possible to compare the moral and causal judgment performance of children who were high and low on the measure of decentration. In addition, it was possible to study the relationship between all three cognitive capacities and the age, sex, and intelligence of each subject.

2. *Subjects*

The subjects for this study were 120 pupils of a school in a suburban middle-class community, in Grades 2, 4, 6, and 8. Classes were selected that had exactly 30 pupils and in which there were equal numbers of boys and girls. Most children were of slightly above average intelligence, with a mean *IQ* of 113.3 for the total group. The mean ages for the four grade samples were 7:9, 10:1, 11:9, and 13:9 years, respectively. All children in each group were tested in school with the exception of one boy who was tested at home where he was confined with a broken leg.

3. *Instrument*

The instrument was primarily patterned after items used by Piaget. Some original items were added to those found in Piaget's work on moral judgment

(9), causal judgment (6, 7) and spatio-perceptual judgment (7, 11). Moral-judgment items fell into the areas of immanent justice (moral, as opposed to physicalistic, laws governing social relations), expiatory punishment (punishment should be used to exonerate guilt), and objective responsibility (the consequence rather than the intent of actions is what matters). All of the moral-judgment items were of the familiar story-judgment type. The causal-judgment items all called for explanation of natural phenomena, such as night, rain, and dreams. The three categories of decentration items were slightly more complicated. The lateral discrimination items called for judgments of laterality at increasingly sophisticated levels. The spatio-perceptual items called for the graphic representation of configurations as if seen from different vantage points. The social decentration items called for evaluation of complex social situations, such as the following:

> In order to make a lazy boy work harder, the teacher told everyone in the class not to help him with his work. One of the boy's friends broke the teacher's rule because he wanted to help all the same.
>
> What do you think of the friend? Was he right or wrong? Why? And the friend who helped? Why? And the friend's mother, what did she think? Why? And what do you think other children in the class thought? Why?

A mature response to this item was one in which there was a balanced diversity of opinions with the viewpoints of the children differentiated from those of the adults. Furthermore, at least one of the actors must be accorded a judgment in relativistic terms: i.e., neither all black nor all white. Finally, the behavior of one of the actors, at least, must be termed as a response to the action of the other actors. A similar approach is seen in the work of Feffer (1).

In all, 113 items were pretested. Items were selected for inclusion in the final instrument only if they met all of the following criteria: (*a*) they were comprehensible to children at all ages to be studied, (*b*) they were of interest to all children to be studied, (*c*) they differentiated among the responses of children at all ages to be studied, and (*d*) they yielded scorable responses. The original bank of items was reduced to 23 that met all criteria.[2]

The scoring of all items followed procedures set down by Piaget and Lerner (4). All responses were scored independently by a team of three judges. Each area was scored by a different team, so that, in all, nine judges (who were graduate students in educational psychology) participated in the scoring.

The entire instrument was analyzed through Thurstone's centroid factor analytic method. This analysis yielded five orthogonal factors: immanent justice (IJ), composed of two items; objective responsibility (OR), composed of three items; physical causality (PC), composed of four items; social decentration (SD), composed of three items; and lateral discrimination (LD), composed of three items. The remaining eight items did not attain sufficiently high factor loadings. This resulted in the exclusion of the expiatory punishment area from subsequent analysis. Spatio-perceptual decentration was highly loaded with social decentration. Because of the *a priori* assumption that the three decentration factors were interrelated, a Kuder-Richardson Form 20 reliability coefficient was computed and reached a high level (for this type of research) of $r = .72$. This was considered sufficient justification for treating the items in this area as a single decentration index (DI).

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[2] Each item calls for from two (moral judgment questions) to 12 (physical causality questions) answers.

D. Results and Discussion

To test the relationship between the ability to decenter and the ability to render mature moral and causal judgments, the entire sample was dichotomized into high and low decentrating children, and the judgment of the two groups was compared. The results of this analysis are shown in Table 1. Significant differences appear between the responses of high and low decentraters, as measured by the DI, for all three judgment areas. Of the three components of this index, SD appears to make a great contribution to the differences between the two groups.

To test the effect of decentration, with age and intelligence controlled, the four age groups and three intelligence groups were dichotomized into high and low decentraters. Table 2 shows that with age controlled, significant differences appear only for OR responses at both ages and for PC responses of older children. Differences do not appear in the LJ responses, which suggests that age rather than decentration may be of central importance in this area. Table 3 shows that, with intelligence controlled, significant differences appear between the performance of high and low decentraters for OR responses at all levels of intelligence, and for all areas of judgment among children at the highest intellectual level. These results suggest that IJ is more sensitive to intelligence than to decentration.

Because decentration can be seen as a strong influence upon maturity of judgment at higher age and intellectual levels, a question might be raised as to its dependence upon age and intellectual maturity. Table 4 presents the results of an analysis of variance of response in all judgment areas as a function of age, intelligence, and sex. Age and intelligence appear to be important influences upon response level in OR, PC, and DI. Only IJ failed to show any

TABLE 1
COMPARISON OF THE IMMANENT JUSTICE, OBJECTIVE RESPONSIBILITY, AND PHYSICAL CAUSALITY RESPONSES OF HIGH AND LOW DECENTRATING SUBJECTS
($N = 120$)

Response	Judgment area	Decentration index		Social decentration		Spatio-perceptual decentration		Lateral discrimination	
		Low (per cent)	High (per cent)	Low (per cent)	High (per cent)	Low (per cent)	High (per cent)	Low (per cent)	High (per cent)
Immanent justice	Immature	38	14	36	14	32	18	29	20
	Mature	20	28	20	31	24	26	24	27
χ^2		11.51***		5.52		2.81		1.67	
Objective responsibility	Immature	52	8	46	15	42	18	41	19
	Mature	11	29	9	30	13	27	12	28
χ^2		35.59***		29.10***		14.94***		15.69***	
Physical causality	Immature	39	12	36	16	33	19	36	15
	Mature	21	28	20	28	22	26	19	30
χ^2		14.31***		7.28**		3.23		10.57**	

** $p < .01$.
*** $p < .001$.

positive correlation, which might be an artifact of inadequate testing (it was represented by only two items) or might suggest that children attain maturity in this area at ages below those of the subjects in this study. Only PC showed a positive correlation with sex, which suggests the possibility that cultural

TABLE 2

Comparison of Immanent Justice, Objective Responsibility, and Physical Causality Scores of High and Low Decentrating Subjects as Measured by the Decentration Index, by Age

($N = 120$)

Age level	Immanent justice Immature (per cent)	 Mature	Objective responsibility Immature (per cent)	 Mature	Physical causality Immature (per cent)	 Mature
7-9						
Low decentrater	50	31	75	7	58	12
High decentrater	7	12	5	13	23	7
χ^2	1.36		19.54***		.02	
11-13						
Low decentrater	22	16	30	10	20	12
High decentrater	20	42	7	53	18	50
χ^2	2.47		22.63***		5.69**	

** $p < .02$.
*** $p < .001$.

TABLE 3

Comparison of Immanent Justice, Objective Responsibility, and Physical Causality Scores of High and Low Decentrating Subjects as Measured by the Decentration Index, by Intelligence

($N = 120$)

Intelligence level	Immanent justice Immature (per cent)	 Mature	Objective responsibility Immature (per cent)	 Mature	Physical causality Immature (per cent)	 Mature
Low ($M = 96.2$)						
Low decentraters	40	13	68	5	55	18
High decentraters	32	15	5	22	15	12
χ^2	.30		18.85***		.86	
Middle ($M = 111.41$)						
Low decentraters	46	15	45	12	35	13
High decentraters	10	30	10	13	20	32
χ^2	7.78**		9.72**		3.77	
High ($M = 132.0$)						
Low decentraters	32	3	45	5	35	5
High decentraters	20	45	18	32	25	40
χ^2	11.69***		10.67**		6.41**	

** $p < .01$.
*** $p < .001$.

influences may be a factor in contributing to differences in the interests, and, thereby, competence of boys and girls.

The fact that age and intelligence are strong factors in children's acquisition of the ability to decenter suggests that the effect of decentration, as measured in this study, may generally be restricted to the upper age and intellectual levels. In other words, if only older, brighter children can decenter, then younger, less gifted children cannot properly be differentiated according to this ability, nor can it be seen as a factor in their general cognitive development.

TABLE 4
RESULTS OF ANALYSIS OF VARIANCE OF ALL JUDGMENT AREAS AS A FUNCTION OF AGE, INTELLIGENCE, AND SEX[a]
($N = 120$)

Judgment area	Source	*df*	*SS*	*Ms*	*F*
Immanent justice	Age	3	28,035	9,345	2.15
	IQ	2	18,102	9,050	2.08
	Sex	1	2,167	2,167	0.49
Objective responsibility	Age	3	94,929	31,643	14.32**
	IQ	2	23,994	11,997	5.43**
	Sex	1	3,000	3,000	1.35
Physical causality	Age	3	127,025	42,342	11.20**
	IQ	2	30,467	15,234	4.03*
	Sex	1	33,075	33,075	8.75**
Decentration	Age	3	174,825	58,275	16.93**
	IQ	2	50,017	25,009	7.27**
	Sex	1	3,009	3,009	0.87

[a] No multiple interaction yielded significant effects.
* $p < .05$.
** $p < .01$.

In a further analysis of these results, a procedure designed by Kuel was used to locate specific significant differences in the performance of children at varied age and intellectual levels (14). It was clearly seen that significant differences appear at the upper ends of both the age and intelligence continua. In other words, decentration may be an ability that older and brighter children more readily attain, or it may be attained by less gifted children only at later ages.

E. CONCLUSIONS

The principal conclusion of this research is that the ability to decenter, and particularly the ability to decenter social relations, is positively correlated with the ability to render mature moral and causal judgments. There is some evidence for two other conclusions: first, that this relationship is most strongly seen among older, more intelligent children; and second, that decentration may be a general ability cutting across several performance dimensions.

Piaget has attributed a pivotal role to decentration in children's acquisition of more complex cognitive capabilities. It follows that given training in the ability to decenter, children might improve their general level of cognitive performance. In such a view, decentration can be viewed as a "learning set" (2, p. 124) that might "be used to prepare the child for later operational levels" (17, p. 302). Research has been undertaken in training children, in conversation, in the realization that an object can remain stable on a particular dimension despite changes in other, irrelevant dimensions. Reinforcement, differentiation, inference, and training in reversal have all been used as training procedures with varied results (12, 13, 15). The chief shortcoming of this research is that training periods are generally restricted to brief periods. As training procedures are refined and as training is undertaken in a more ambitious program, results may well improve.

F. Summary

The moral and causal judgment of 120 children in Grades 2 through 8 were shown to correlate significantly with the ability to decenter. Decentration and mature judgment were shown, in turn, to correlate with age and intelligence. It was suggested that older, more intelligent children develop the capacity to decenter more readily than do younger, less intelligent children. However, it is possible that training in decentration may aid children in moving more swiftly toward cognitive maturity.

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FEARFULNESS IN THE CONTROL AND IRRADIATED RAT*

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A. Problem

Furchtgott and Echols (1) have presented data that they interpret as reflecting greater fearfulness for fetally and neonatally irradiated rats than for control rats. Their tests included tilting cages, an open field, and home-cage emergence.

The present study used an open field with a darkened tunnel leading from one side. Both time to emerge from the darkened tunnel to the open field and time to escape from the open field into the darkened tunnel were used as measures of fearfulness. The study was conducted with adult rats.

B. Materials and Methods

1. *Subjects*

Ten control and 10 whole-body irradiated, male Sprague-Dawley rats served as *S*s. The *S*s were approximately five months old when the study was initiated. The irradiated *S*s had received 500 R in 50 seconds of whole-body exposure to gamma radiation.

2. *Apparatus*

The apparatus consisted of a white-painted open field measuring three feet by three feet with eight-inch sides and a black-painted wooden tunnel measuring six inches by six inches by two feet. The darkened tunnel opened into the open field at the center of one side. It was hinged at the top to permit placement or removal of *S*s.

3. *Procedure*

Each *S* was placed in the darkened tunnel on Days 7, 14, and 21 post-exposure, and the time to emerge to the open field was recorded. A maximum of five minutes was allowed. On Day 28, each *S* was placed in a corner of the

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open field opposite the tunnel and the time to enter the tunnel was recorded. Again, a maximum of five minutes was allowed.

C. Results

Figure 1 shows the mean time taken by the *S*s of the two groups to emerge from the darkened tunnel during successive test periods. As is obvious from the figure, none of the *S*s emerged during the maximum time limit of five minutes.

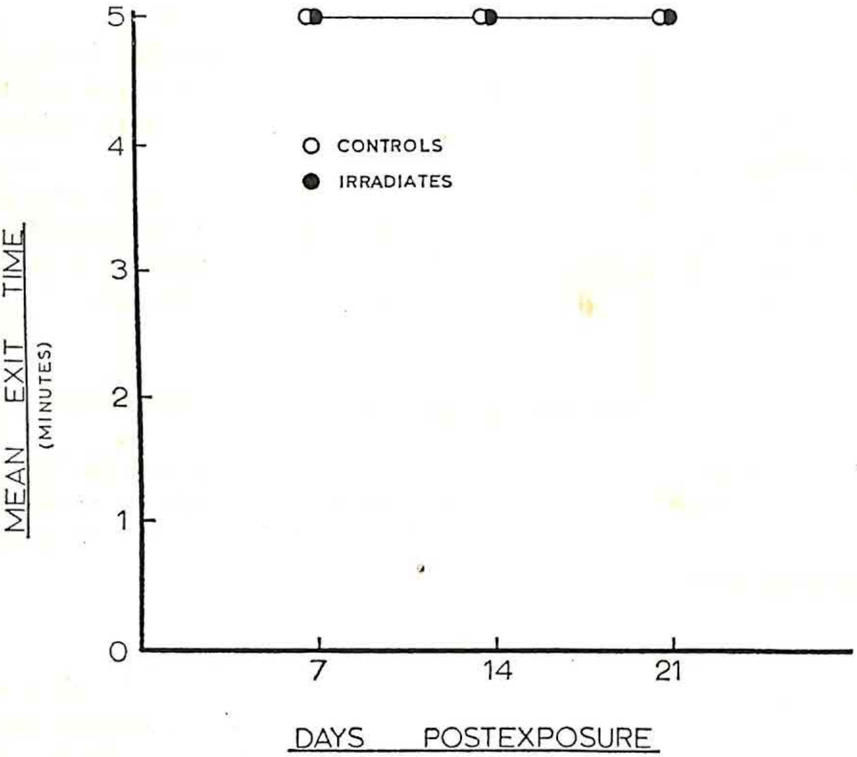

FIGURE 1
Mean Exit Time from the Darkened Tunnel for the *S*s of the Two Groups During Successive Periods of Testing

Figure 2 shows the mean entrance time for the *S*s of the two groups on Day 28. The control *S*s took, on the average, less than one-half the time taken by the irradiated *S*s to escape from the open field. The difference between the escape times of the *S*s of the two groups is beyond the .02 significance level as measured by the Kruskal-Wallis one-way analysis of variance by ranks (2).

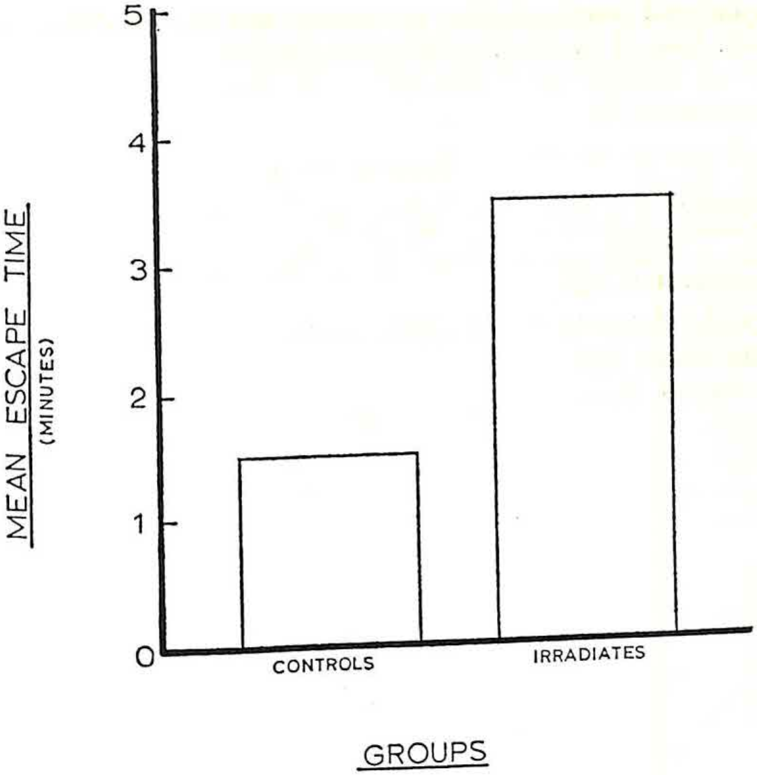

FIGURE 2
MEAN ESCAPE TIME FROM THE OPEN FIELD FOR THE *S*s OF THE TWO GROUPS

D. DISCUSSION

The data of the present study fail to show any difference between control and adult irradiated rats with respect to entrance to an open field from a darkened runway. The data do show, however, that control rats are much faster to escape from an open field than are irradiated rats. This suggests to the authors greater fearfulness for the control rats than for the irradiated rats.

Such an interpretation is in direct contrast to that of Furchtgott and Echols (1) and possibly reflects, more than anything, the differences in age of the *S*s at the time of exposure in their work and in the present study.

E. SUMMARY

Ten control and 10 irradiated rats given whole-body exposure to 500 R in 50 seconds of gamma radiation were tested for entrance time to an open field

from a darkened tunnel and, also, for entrance time into the tunnel from the open field. None of the *S*s entered the open field from the tunnel. The control *S*s, however, escaped from the open field to the tunnel significantly faster than did the irradiated *S*s.

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TOWARDS A DIFFERENTIATED CONSTRUCT OF CURIOSITY*[1]

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A. INTRODUCTION

On first thought there seems little need for a precise definition of the term "curiosity" with its attendant inclusions of certain phenomena and exclusions of others. Nor does it appear to require so formal a status as "construct" with the implied problems of categorization, generality, defining operations, and validity. The very folksy familiarity of the term "curiosity" and the promiscuity of its application—both lay and, recently, scientific—give it a deceptive simplicity. Curiosity, in its conventional usage, is many things. A person is curious (a trait varying among individuals, with presumed stability over time and generality across situations); a situation is curiosity-evoking (a characteristic of the environment triggering certain responses for more or less everyone). One is too busy or too tired to be curious (a motivational state dependent upon, or interacting with, other transitional conditions of the individual) or is just not curious about a particular situation (a motivational state linked with relatively stable individual differences in interests among individuals). When a person gets bored and goes out looking for excitement, when something catches his eye in passing or holds his attention over a long period, when he writes a poem or comes up with a scientific hypothesis—in all these he has, in some sense of the word, shown curiosity.

Is this apparent inconsistency in usage of the term simply an indictment of the imprecision of language? Possibly, but if the same term serves so widely, may we suspect that the inconsistency is more apparent than real? Perhaps there exists a definitional core shared by the various meanings and usages of

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[1] This paper was initiated during a USPHS Special Research Fellowship (1962-1963) to the Tavistock Child Development Research Unit (London); John Bowlby, sponsor. A preliminary version was presented at the Unit's research seminar, conducted by Marie Jahoda, and I am deeply indebted to Dr. Jahoda for her detailed criticism. M. Brewster Smith has done the same for the present draft, for which I am equally grateful.

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the term "curiosity." Its rapidly-growing literature seems an obvious place to begin our search.

B. SOME DATA ON CURIOSITY

The simplest, if oversimplified, summary that can be offered of published research on curiosity is that it focuses primarily upon the role of external stimuli in evoking curiosity behavior with some secondary emphasis on the effects of variation in internal factors. To give a few scattered examples, we know that lower primates will perform work "just" to look outside (7) and prefer a clearly focused (8) and visually undistorted (24) view of things; that rats will explore when otherwise known biological drives are sated (25), but are less likely to do so when brain-damaged (17); that infants and chimps (10, 11), as well as people (5), would rather look at bright, colored, or complex stimulus patterns.

The amount of progress that has thus far been made towards an understanding of curiosity has been possible without an explicit and consensual definition of the class of behaviors called curiosity. Implicitly, we may have been assuming that curiosity is so familiar a term that investigators are sure to have selected reasonable measures of the construct. Their selection has, however, been highly varied. Thus, among manifestations of curiosity have been included orienting reflexes, locomotor explorations, and investigatory responses—even play, humor, gambling, and artistic creativity. Such diversity in the defining operations of curiosity would seem to call for a wide range in its definition and conceptualization. This is certainly the case, as will be seen. Even this listing is a very limited selection of phenomena that have been credited as relevant to curiosity. This wide compass suggests that curiosity appears to many of us as a useful way of slicing behavior, one which promises later synthesis. But let us proceed to an inventory of definitions and conceptualizations of curiosity.

C. SOME DEFINITIONS OF CURIOSITY

It is useful, although only possible with considerable conceptual strain, to maintain a distinction between definitions of curiosity as a motivational construct on the one hand and as a class of adaptive behavior on the other. The two facets, as will be seen, are closely linked, but relative emphases do vary. For Berlyne (6), curiosity appears to refer to a wide range of behavioral events for which we can recognize no specific biological function. Berlyne, however, is explicit in considering curiosity as a drive state induced by experienced uncertainty or, more generally, by lack of sufficient information in a given environmental situation. White (30) seems also in the motivational camp. His concept of competence—"an organism's capacity to interact effectively with its environment"—requires the participation of a motive much like curiosity in order to account for the fact that this interaction "cannot be wholly derived from sources of energy currently conceptualized as drives or instincts" (30, p. 297). Here, the term "effectively" makes a bow towards adaptive behavioral description, eliminating, it would seem, such items as aimless wandering and daydreaming.

Other writers also stress the motivational aspect, but, rather than defining the drive involved by default—i.e., no known biological drive—prefer to risk the charge of teleology and to define curiosity in terms of its ultimate goal or effect. Bartlett's (2, 3) "effort after meaning" is one pure example of this type, but the assortment of definitions that attribute curiosity to anxiety-reduction, reality-testing, or a search for excitement all seem of the same sort. Again, none of these views places restrictions on qualifying behavior: any action will do as long as it may be interpreted as being in the service of these needs. Closely allied with these approaches are views that invoke surplus energy or a need to (or pleasure in) exercise sensory or motor apparatus for curiosity as the motivational source.

Yet another class of views seems to skirt the brink of tautology, positing unique motivational bases for the particular classes of behavior they wish to investigate: "need cognition" (9); "perceptualization need" (22); the collection of *ad hoc* drives—e.g., for exploration, for manipulation—that characterize the work in this area of comparative psychologists. In these the behavioral referent is clear, if broad, but there seems little attempt to derive a broad functional classification under which the several categories of activity might be subsumed.

This brief review, at least, documents the undeniable existence of something called curiosity which requires conceptualization. To provide a workable definition and a viable descriptive schema for this class of phenomena is the immodest intent of the present essay. With the caution that what follows finds its parentage more in the armchair than in the laboratory, it may proceed.

D. The Development of a New Definition

Berlyne's definition of "epistemic behavior"—a subclass of "ludic behavior"—provides a convenient starting point. It is behavior that augments knowledge, characterized by "certain highly specialized information-gathering and information-storing processes dependent on symbolic processes" (6, p. 262).

This definition is implicitly neutral with respect to motivational source, apparently eclectic regarding behavioral criteria, and noncommittal regarding biological function. Embracing these features leads to the present definition: *Curiosity is a tendency, or motive, to acquire or transform information under circumstances that offer no immediate adaptive value for such activity.* For "activity," one may prefer to read "behavior," but this deliberate hedging permits easier inclusion of phenomena not directly observable, such as thinking. Equally deliberate is the avoidance of any commitment to a motivational source although, strictly speaking, the phrasing is probably of a piece with the "no known biological drive" orientation. On a more distal level, however, it does seem that curiosity, particularly as here defined, can be assigned a sensible evolutionary origin. It is difficult to conceive of an activity more effective in assuring the survival of the individual in changing circumstances than the wide-ranging collection of immediately irrelevant information, provided that it does not, at a given moment, take precedence over adaptation to more urgent environmental challenges. This is no more than to say that the oft-heralded human characteristic of foresight can easily be regarded as a by-product of natural selection through the operation of curiosity.

Two further qualifications should be made for the definition: (*a*) "No immediate adaptive value" means, in Lewinian terms, that the valence of the activity cannot be deduced from any derivative of biological drives in the life-space of the individual. (*b*) "Acquires information" is neutral with respect to the individual's intention or lack of intention to do so, and to any awareness of having learned something. Hence, "incidental learning" phenomena are not disqualified, so that the general principle, in both animals and men, that such learning is inhibited to the extent that biological drives are active has useful implications. For one thing, these data support the hierarchical conception (19) that curiosity cannot overrule immediate survival needs, which, as noted earlier, an evolutionary view would require. And, more generally, when there is no worrying at this point about intent and awareness, unhampered access to subhuman comparative data is assured. Presumably, experimental situations can be devised wherein the acquisition of information can be demonstrated behaviorally, no matter the species; and when this has occurred under "unmotivated" circumstances, a legitimate curiosity datum is in hand.

Only the word "information" remains uninspected, and not by chance alone. It is intended in the information-theory sense which, aside from its current fashionableness, seems to offer the possibility of quantifying both changes in the organism and in characteristics of the environment. Since commerce between organism and environment is the essence of curiosity, the promise of a common metric is irresistible. It seems possible to fit situation determinants of curiosity and its behavioral expressions within the same informational framework. But, first, a few conventions to be used from now on: although, in information-theory parlance, one can speak of (and measure) the amount of information required to describe a given stimulus situation—or, equivalently, its degree of uncertainty—the notion of the complexity level (CL) of an *environmental* "pattern" seems preferable, with the terms "information" and "uncertainty" held in reserve for experienced complexity, a process occurring *within the organism*. Thus novelty, a prime determinant of curiosity, must be defined in terms of the discrepancy between the CL of a presented stimulus and the amount of information regarding the stimulus already in the possession of the organism. Seen in this way, it becomes less likely for an investigator to seek general relationships between stimulus characteristics and curiosity behavior, but, instead, he will allow conceptually and experimentally for the mediation of a third parameter—the already-available information or the information-processing capacity of the subject with respect to the presenting stimulus.

Such an elaboration in framework is implicit in recent research which has shown that evoked curiosity may be a nonmonotonic function of stimulus complexity—roughly an inverted "U"—and that the nature of the function relating the two varies with the age of the responding organism. For example, Hershenson, Munsinger, and Kessen (15) reported that newborn infants prefer to look at shapes involving 10 angles when paired with either five-angle or 20-angle shapes. Ames and Silfen (1), working with "checkerboard" stimuli varying in complexity, found that the preferred CL shifts upward when comparing 20-week-old infants to an eight-week-old group. The temptation to read "information-processing capacity" for "age" is heightened by the general finding that intelligence and curiosity covary. For example, in a series of papers, Maw and Maw (20, 21) found that more curious children prefer more complex figures, have greater verbal comprehension, and possess more general information than less curious children. Apparently, then, the optimal (most curiosity-arousing) level of complexity lies at some value intermediate within the possible range and that level increases with the knowledge and ability of the individual *vis à vis* the stimulus. Bracketing data for this assertion are not hard to come by; for example, "white noise" is, in a certain sense, a pattern of maximum CL and, by the same token, a pure tone possesses minimum CL, yet neither normally arouses curiosity (except at its introduction and cessation), presumably because they are too complex or too simple.

The necessity to credit within-the-organism factors is perhaps made most strongly by the data indicating that a given stimulus becomes increasingly less curiosity-evoking as it becomes more familiar; i.e., as the individual reduces through experience the discrepancy between the CL of the pattern and what he now knows about it. Fantz (12) has shown that infants (aged two to six months) spend increasingly less time over 10 successive one-minute exposure periods looking at a constant stimulus pattern, relative to a paired pattern that is changed at each period. Berkson and Fitz-Gerald (4), working with infant chimpanzees, found much the same thing; their animals spent a regularly decreasing proportion of time looking at a continuously-presented stimulus as the exposure period progressed.

Incongruity inevitably involves the factor of individual experiences: the CL of a picture of a hybrid animal (a lion's head with a camel's body—one of Berlyne's stimuli) may be no greater than the CL of a picture of either whole animal. But, clearly, the former requires more information for its description than does the latter. Hunt reflects this view in defining incongruity as "the discrepancy between the incoming information of the moment and that information already . . . stored in the brain" (16, p. 85).

In short, then, the distinction between the complexity of a stimulus and the information required by an individual for its processing, or understanding, seems a useful one. Furthermore, it is evident that all behaviors by which curiosity is commonly expressed—orienting, exploring, examining, even thinking—are alternative means whereby an organism acquires information. The choice in a given situation, apart from the demands of the immediate stimulus, will be influenced by the individual's learned preferences as well as his relative endowments (e.g., his intelligence, the effectiveness of his receptors) which serve the acquisition of information. Also, any sense modality can serve this function, though with varying efficiency in different species. The amount of information acquired through each can, theoretically, be measured. But what of variation in these relationships within the individual? It seems likely that not only do such biological states as hunger, fear, and fatigue, when sufficiently intense, totally inhibit curiosity, but also that in their milder forms they may shift the curiosity-optimal-complexity level downward.[3] Here Tolman's (28) hypothesis and evidence that drive states cause a narrowing of the organism's "cognitive map," hence a reduction in "latent learning," are much to the point. In Tolman's terms, when we are "overmotivated" to achieve a specific goal, our perceptions are highly focused on the "relevant" and are unlikely to admit information that for the moment is irrelevant.

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[3] Penney (26) reports consistently negative correlations between curiosity and manifest anxiety in several groups of elementary-school children. Mendel (23) finds the same in preschool children.

A last question: what is the mediation of the apparently "autonomous" fluctuation that is so typical of curiosity—the child's seemingly insatiable "getting into things" so quickly followed by the rapt attention to the completely predictable, favorite fairy tale?[4] Glanzer's (13) "stimulus satiation" hypothesis, which does well in accounting for spontaneous alternation behavior in mazes, seems inadequate here. The mercurial nature of a child in shifting from one state to another defies the orderly falling off and renewal of interest, which Glanzer calls for.[5] Rapt attention to the familiar may be a defensive maneuver, born of a need to escape from the excessive stimulation that a foray into a new situation has brought. Perhaps. But why is a repetition of a thoroughly-known experience sought; why not just "rest" in a state of non-stimulation? Here, Hendrick's (14) postulation of an "instinct to master" seems helpful. He suggests that there is intrinsic reward in running off a successfully mastered behavior; so the comprehension of a familiar fairy tale may be by itself rewarding to the child, as well as reaffirming his capability to handle at least some complexity at a time when his ability to handle uncertainty is quite low.

It is when we come to consider such time-linked phenomena that limitations of traditional laboratory experimental setups for studying curiosity become most apparent. Laboratory experimentation, of course, always involves some fractionation of the phenomena under study and some restrictions of the conditions under which they are assessed. But with curiosity, which almost by definition requires study in a naturalistic setting, traditional strategy will entail an unusually high cost in "artificial" units and limited generality of results. To sound this *caveat* is of course much easier than to heed it in an experimental setup. What we require ideally is an "open field" situation in which the subject is free to wander about and to select what he will from the available patterns and to do as he chooses with them. To make observations in such a setting for the unrestricted and peripatetic human subject would require a miracle of instrumentation. Equally challenging is the task of devising a descriptive schema capable of transforming the resultant chaos of observational data into useful categories. The present paper attempts only a small start on this last requirement.

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[4] Schachtel (27) would not agree that an oft-told tale has near-zero uncertainty for a child. Arguing within the framework of "allocentric" or reality-oriented perception, he maintained that the child is not passively absorbing a reassuring comprehensible story, but, rather, is actively working at assimilating it in all its detail. What may be soothing or boring to the adult may still present a challenge to understanding for the child. Schachtel's discussion of this phenomenon (27, pp. 259-265) and, indeed, his general discussion of allocentric perception seems of considerable relevance for the student of curiosity.

[5] Wenar's (29) concept of "executive competence," which he developed in his stimulating analysis of curiosity behavior in the first year of life, would regard such a flitting about from object to object as indicative of *low* curiosity.

E. A Schema for Curiosity Behavior

What is being proposed here is a set of categories sufficiently molar to comprehend naturalistic, hence meaningful, units of curiosity behavior and to capture the transitions and sequences that seem to characterize such behavior. Throughout the author will be speaking of experienced complexity, the resultant of the CL of the environmental pattern and what the individual already knows about it.

In what will be called Seeking Curiosity, the focus is on the experienced complexity of the immediately present pattern that determines when—i.e., at what level of uncertainty—the individual bestirs himself and alters his environment in such a way that informational input is modified. He may seek increased complexity or he may be evading excessive complexity. Thus, rather than to speak of a point threshold, it may prove more appropriate to consider a transitional region within which seeking behavior is not initiated. The relevant determinations here would be the upper and lower thresholds of this region, beyond which the individual would "leave the field" in search of a change in experienced complexity.

After these limits, outside of which stimulation is sought, have been established we can proceed to ask how complex is the experience the organism seeks. More operationally, what is the level of complexity of the new situation that terminates Seeking Curiosity. This is Noticing Curiosity, again probably a band of uncertainty, rather than a point, within which new patterns attract attention. The view out the window may be too dull, the new book on the table too demanding, the play of children just interesting enough.

Once noticed, what is the holding power of a given situation or, put another way, what degree of experienced complexity is optimum for maintaining interest? The optimum value for this third category, Examining Curiosity, need not coincide with that for Noticing Curiosity, nor even necessarily fall within its range. What can attract or distract may not hold attention, as witness browsing through a collection of old prints where so many catch our eye (content? color? frayed edges?), yet so few survive the glance stage. In a free situation we cannot examine what we do not notice, an artificial contingency which would seem to require that the optimum level for Examining be contained within the Noticing range. Yet it may be that for some of us this restriction does not hold—that we become most intrigued by a pattern that we would be unlikely to notice spontaneously, but that has been explicitly pointed out to us.

A juxtaposition of curiosity behavior observations for Noticing and Examining data, for example, might tell us something useful about the cognitive style of an individual. One person may notice only patterns within a narrow band of experienced complexity, which, in turn, maintain his intense interest over considerable periods; another may notice patterns within a rather broad range, with his peak Examining level associated with a pattern somewhere midway in this range. Yet another man can be shown to become most absorbed in highly complex patterns far beyond the limits of what he usually notices. Making the leap to an informal characterology, we might then regard the first gentleman as rather hyperefficient and single-minded, the second as flexibly and adaptively curious, the third perhaps as too well-defended against the challenges of his environment. Were we to include Seeking Curiosity in these profiles, such characteristics as restlessness, distractibility, and perseverance would enter into an elaboration of these sketches of cognitive styles.

These three categories of curiosity, taken together, can be seen as setting up some kind of cycle within which behaviorally abrupt transitions from one to the other can be attributed to the wavering balance between information being acquired by the organism and the complexity presented by the environment. Underlying this process, on a genotypic level, would be a single continuous function—the degree of uncertainty being experienced at any given moment by the individual. It seems possible to break into this three-category cycle at any point and to move in either direction. To take some examples: we are examining a difficult passage, we reread it a few times and finally begin to understand it. Uncertainty decreases and, at some point, the complexity of another pattern in the periphery of attention is noticed, proves fascinating, and is turned to for closer study. Or the passage is sufficiently understood, ceases to be interesting, and we look about seeking diversion. Presumably this cyclical variation would operate along a stimulus pattern baseline made up of three overlapping CL distributions of experienced complexity, defining the limits and optimum points for Seeking, Noticing, and Examining Curiosity.

These three categories may all be regarded as environmentally determined or, perhaps more precisely, environmentally dependent. In each it is the experience of uncertainty related to patterns given in the outside world that we are concerned with. But what of self-determined patterns—doodling, daydreaming, painting a picture? (This inclusion of wholly "mental" with physically observable behavior is intentional, despite the measurement problems implied.) This category of Productive Curiosity would seem to be orthogonal to the domain defined by the first three. The distinction here is one between the input and output of information or, rather, between the organism, on the one hand, reducing uncertainty and, on the other, creating it. The phrasing may be awkward, but the author can see no logical difficulties inherent in encompassing the production of uncertainty within the present conception of curiosity behavior. Neither do there seem to be any unique problems of measurement: the complexity of a pattern we produce is, metrically, no different from ones we select from the environment. The artist, in creating a painting, sets for himself a certain level of complexity, solves the problem in the course of execution, and—as some have confessed—has so reduced its uncertainty by the time of its successful completion that it no longer maintains his interest. In other words, the CL of the finished product may be considerable, but it no longer holds mystery for the artist. The gallery visitor viewing the product may very well recapitulate the same sequence, from the information point of view, with the difference that his first step is to notice it, then to examine and comprehend it, and finally to go off in search of another aesthetic "problem."

Productive Curiosity could take its departure from any one of the three input categories; at any point in the sequence they describe, a shift from reception to action could take place. Its introduction raises further researchable questions. Does, for example, preferred complexity in Productive Curiosity correspond to that for Examining Curiosity? At first blush, this would seem a reasonable hypothesis, since both derive from situations where undivided attention is possible and self-selection assured. Yet, for some, the active-passive distinction inherent in this comparison may have critical connotations and result in sharply differentiating behavior. The critical scholar may study most intensively the most difficult of manuscripts, but in his own writing emit almost simple-minded products. There is some experimental support for this general notion. Maddi and Berne (18) report a significant *negative* relationship between desire for novelty (Seeking Curiosity?) and the degree of novelty shown in producing stories. From this and other work they postulate the existence of "active and passive forms of the need for variety" (18, p. 276). One might hazard the guess, at this point, that a person's relative preference (or is it an ability?) for producing complexity as opposed to reacting to uncertainty—his input/output ratio in curiosity behavior—is a highly stable individual-difference parameter. In any event, Productive Curiosity seems an inevitable category whether or not the input-output dichotomy is found to possess some special heuristic advantage. And it is certainly one that has been relatively neglected, possibly because of its presentation of certain methodological difficulties.

The intent of this essay has been to call attention to the considerable differentiation readily apparent in the realm of curiosity behavior. The definition of curiosity offered here and the discussion of some of its possible subcategories are to be taken as illustrative of the kind of analysis required to guide experimental work on this deceptively simple and familiar construct. An uncritical and usually only implicit assumption that all behaviors that fall within the ordinary definition of curiosity are interchangeable, one with the other, can only lead to theoretical muddles and wholly spurious "contradictions" between experimental outcomes. Psychology has often run the course of assuming generality for a construct only to discover, after many years of fruitless theoretical and empirical debate, that an improved clarity and differentiation of definition would have led to more meaningful confrontations and to more effective research efforts than have been possible with existing conditions. Perhaps the present analysis will help to head off such a detour in the case of curiosity.

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MAGNETIC FIELD EFFECTS ON THE COMPASS MECHANISM AND ACTIVITY LEVEL OF THE SNAIL *HELISOMA DURYI ENDISCUS**[1]

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A. INTRODUCTION

In the light of the great emphasis on space travel and the resulting environmental studies, it has become apparent that the majority of psychologists, biologists, and physiologists have, until recently, taken a very narrow and naive position in their study of the behavior of living organisms. All but a few investigators have failed to deal with the numerous physical environmental factors that impinge on an organism. They have instead concentrated on only those factors to which the organism is specifically and quite obviously sensitive. Without quite rigorous investigations, it would be completely inaccurate to assert that, for example, the visible portion of the electromagnetic spectrum is the only portion to which an organism could respond. It is hoped that the present paper will yield further support to the idea that every organism is influenced by many different and subtle factors in the environment, and that these environmental factors, even though subtle and complexly interrelated, should be taken into account whenever the behavior of an organism is under consideration.

Of major interest here are the behavioral effects of the geomagnetic field and very weak artificial magnetic fields.[3] Frank A. Brown, Jr., one of the first to experiment with weak magnetic fields, recorded the endpoints of organisms allowed to emerge in different field conditions from a corral contained in a flat-bottomed glass crystallizing dish. Field conditions were variable in strength and orientation, the field strength ranging from .25 gauss to 10.0 gauss and the orientation including north-directed, south-directed, and east-

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[3] An extensive review of previous magnetic field research can be found in Becker (2).

west-directed conditions. Endpoints were determined by a polar coordinate grid on which the dish was placed. It was found that organisms such as mud-snails, planaria, paramecia, fruit flies, etc. appear to be affected by the strength and the orientation of the magnetic field and by the time of day, month, and year, as evidenced by the degree of turning of the organism as it emerges from the corral. Although Brown puts quite an emphasis on the relationship of magnetic field effects to the biological clock problem, this is not the most important aspect of the present study. The main points of Brown's work from the standpoint of this paper are as follows. (*a*) Weak magnetic fields affect the orientational behavior of certain organisms. (*b*) Different orientations or degrees of turning are elicited by magnetic fields of different strengths and orientation. (*c*) Orientation and degree of turning are also differentially affected by time of day, month, and year (1, 3, 4, 5, 6, 7).

The purposes of the present investigation were as follows: (*a*) to investigate further the theory that the very weak magnetic field is a significant part of the organism's environment, (*b*) to attempt to achieve results similar to those of Brown with the use of a less involved experimental design and less structured methodology, (*c*) to present further evidence of the importance of time of day and month as significantly differential environmental factors. Both directional behavior and activity level were considered to be indicants of magnetic field effects.[4]

B. METHOD

1. *Subjects*

Ten common aquarium snails, *Helisoma duryi endiscus,* served as *S*s throughout this experiment. These *S*s were acquired from an aquarium supply store and were selected on the basis of uniform size—approximately ⅜ inch in diameter. Each *S* was identified at the outset of the experiment, and individual data were kept on each. The snails were fed commercial fish food twice weekly. Since the field conditions for each day of the week were randomly chosen, it was assumed that feeding did not differentially affect the results. Water temperature remained relatively constant throughout the experimentation, ranging from 70° to 78° F. Lighting on the living boxes was constant for all trials, and the effects of daylight were eliminated by the use of a windowless room.

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[4] A pilot study was conducted, during which a revised methodology—the "whole-compass" technique, described later in the text—was tested. In addition to proving the value of this methodology, the pilot study led to the observation that the magnetic field might influence activity level as well as directional behavior, and to the conclusion that the χ^2 technique is not sufficiently sensitive for the 360° directional analysis required by this methodology.

2. *Apparatus*

The apparatus devised for the "whole-compass" technique is shown in Figure 1. The 15 × 15-inch platform was adjustable from 1 inch to 18 inches

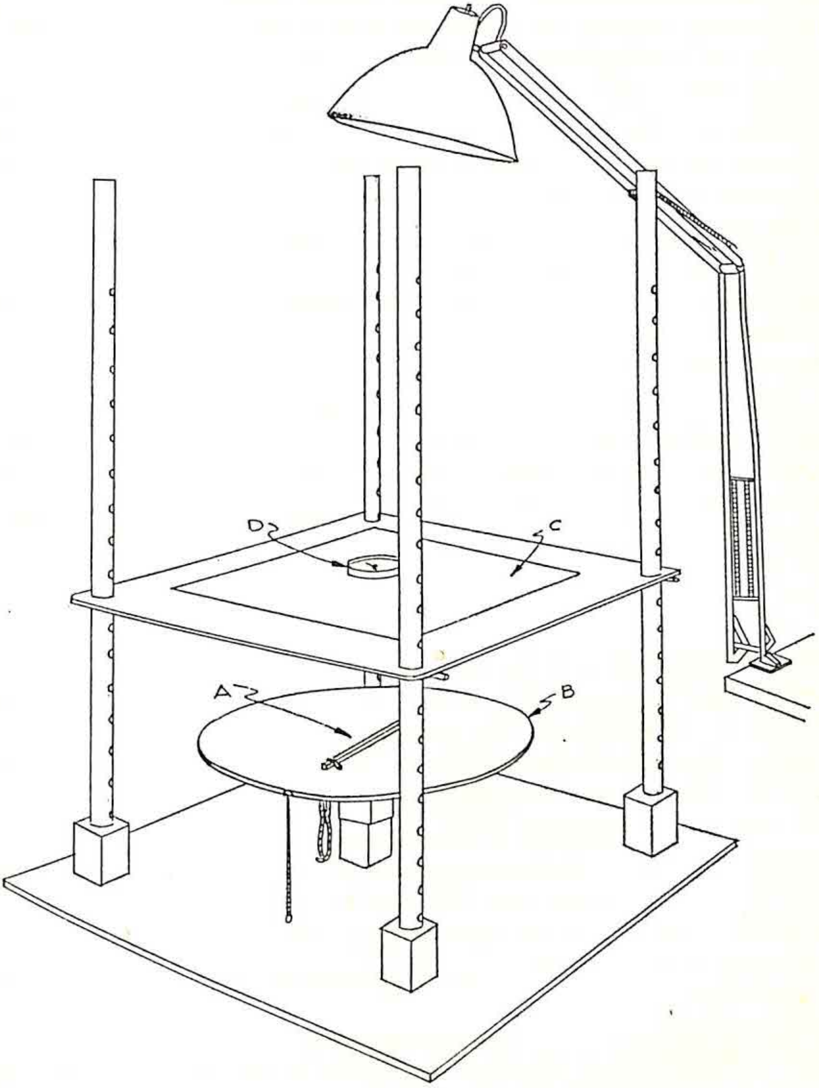

FIGURE 1
APPARATUS SHOWING (*a*) MAGNET, (*b*) MAGNET ROTATOR, (*c*) MANEUVERING BOARD PAPER, (*d*) RUNNING DISH

above the magnet at intervals of 1 inch.[5] The magnet holder was 12 inches in diameter and could quickly and easily be rotated through 360°. The magnet was secured by means of elastic loops, which were attached to the wooden holder and slipped over the two ends of the magnet. Illumination was provided by a 25-watt bulb in a lamp which was extended 1 foot above the center of the running platform. Subjects were run in one of several plastic dishes measuring ¾ inches in depth and 3 inches in diameter. A plastic-coated sheet of maneuvering board paper was used to determine the criterion line and the endpoints from zero degrees to 360°. The criterion line, which was approximately 1½ inches from the starting point, was the third concentric circle from the center of the maneuvering board paper. The ratio of subject size to distance traveled was, thus, 1:4 in the present experiment, while in Brown's experiment this ratio was approximately 1:3. Two plastic 12-section boxes were used to house *S*s individually. Each *S* was identified by a number placed under its section of the box.

The magnet used was a 6-inch alnico bar magnet rated at approximately 1.5 gauss at 6 inches below the running platform.[6] Settings of the rotating magnet holder were color coded so that the three field conditions utilizing the magnet could be changed rapidly, and so that the experimenter need not know the condition being used. The accuracy of these color-coded settings was checked with a compass every few days.

3. *Procedure*

The apparatus was lined up so that the zero-degree point on the maneuvering board paper corresponded to the magnetic north in the earth's field as determined by a pocket compass. The experimental field conditions were created as follows. (*a*) For the Augmented Field condition the magnet was placed so that the compass needle would point north (same orientation as the earth's field). (*b*) For the Reversed Field condition the magnet was placed so that the compass needle would point south (180° change in orientation from the earth's field). (*c*) For the East-West Field condition the magnet was placed so that the compass needle would point east (90° change in orientation from the earth's field). Under the control condition (Earth Field), no magnet was used and the *S*s were run solely in the normal earth's field (approximately .20 gauss).

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[5] The "whole-compass" technique involves placing the snail in the center of a running dish unobstructed by barriers, thus allowing a 360° choice situation. Previous techniques have utilized barriers that allow the snail only a 180° running area. The implications of this technique will be discussed later on in this paper.

[6] The magnet, measured by a Bell 240 incremental gauss meter at the National Bureau of Standards, was rated at 25 gauss at its strongest point.

From November 16 to December 6, 1964, a period of three weeks, three sets of trials were run Monday through Friday—one set between 8 a.m. and 10 a.m., one between 11 a.m. and 1 p.m., and one between 4 p.m. and 6 p.m. Starting *S* and condition (Earth Field, Augmented Field, Reversed Field, or East-West Field) were randomly selected for each day and posted in advance of a week's trials. Three *E*s were carefully trained in techniques of placing the subjects and of judging the criteria for the data recording before the investigation was begun.

Each *S* in turn was removed from the living container and placed in the plastic dish located at the center of the running platform. The *S* was then oriented by hand so that on emerging from the shell it would start moving along the zero-degree line. The trial was not timed until *S* had moved for a short distance (approximately ⅛ inch) along the zero-degree line. If *S* headed in some other direction, it was replaced at the starting point in the center of the dish and again oriented by hand to head in the zero-degree direction. A time limit of four minutes was placed on each trial. If *S* did not reach the endpoint within that time, the trial was counted as a no-run (NR). If *S* did reach the endpoint within the time limit, the duration of the run and the endpoint were recorded, and a sketch of *S*'s approximate path was made. After each run, *S* was returned to the appropriate section of the living box, and the next *S* in consecutive order was run until all 10 *S*s had been run at that particular time.

The measure of direction was taken as the endpoint from 0° to 360° at which *S* crossed the criterion line. The measure of activity level was given by the percentage of runs completed (R ÷ Total trials) under any particular condition.

C. RESULTS

Under the Earth's Field condition, 120 trials were run; under Augmented Field, 112; under Reversed Field, 115; and under East-West Field, 115. In order to analyze more accurately the data collected concerning directional behavior, a new method, Tukey's Test of Orientation [see Shykind (8)], was utilized. The results of the analysis of distributions found under the four magnetic field conditions may be seen in Figure 2. Under the Augmented Field and East-West Field conditions, a trend toward a nonrandom distribution of orientations or endpoints existed, although $C^2 + S^2$ was not statistically significant at the .05 level for these conditions.[7] Figure 3 represents the distributions found under these two conditions. Further analysis on magnetic field distributions was carried out with the use of the chi square (χ^2) technique based on quadrant breaks at 45°, 135°, 225°, and 315°. The three experimental conditions (Augmented Field, Reversed Field, East-West Field) were compared with the control condition (Earth's Field). Data suggest that none of the distributions under the experimental conditions differed significantly from the control condition.

Field condition

EF	AF	RF	EW
1.73	5.65	.90	5.03

Time of day

8 a.m.	12 n.	5 p.m.
3.99	9.34*	5.98

Time of month

1st week	2nd week	3rd week
5.06	1.00	11.87*

Note: df = 2. EF = Earth's Field; AF = Augmented Field; RF = Reversed Field; EW = East-West Field.

* $C^2 + S^2$ significant at .01 level.

FIGURE 2

$C^2 + S^2$ COMPUTED FOR FIELD CONDITION, TIME OF DAY, AND TIME OF MONTH DISTRIBUTIONS

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[7] The quantity $C^2 + S^2$ is treated as χ^2 with two degrees of freedom, where $C = (\Sigma x \cos 2\theta)/(\Sigma \cos^2 2\theta)^{1/2}$ and $S = (\Sigma x \sin 2\theta)/(\Sigma \sin^2 2\theta)^{1/2}$. In these equations θ is the largest angle to be found in each of the class intervals (0°-30°, 30°-60°, . . . , 330°-360°); and for each class interval $\chi = (O-E)/(E^{1/2})$ where O is the number of endpoints observed in that interval and E is the number of endpoints expected in that interval under isotropicity.

Since Brown emphasized that time of day and time of month influence directional behavior, analyses were performed on data collected under three time-of-day and three time-of-month conditions. Figure 2 shows the results of the analysis of distributions found under the three time-of-day conditions.

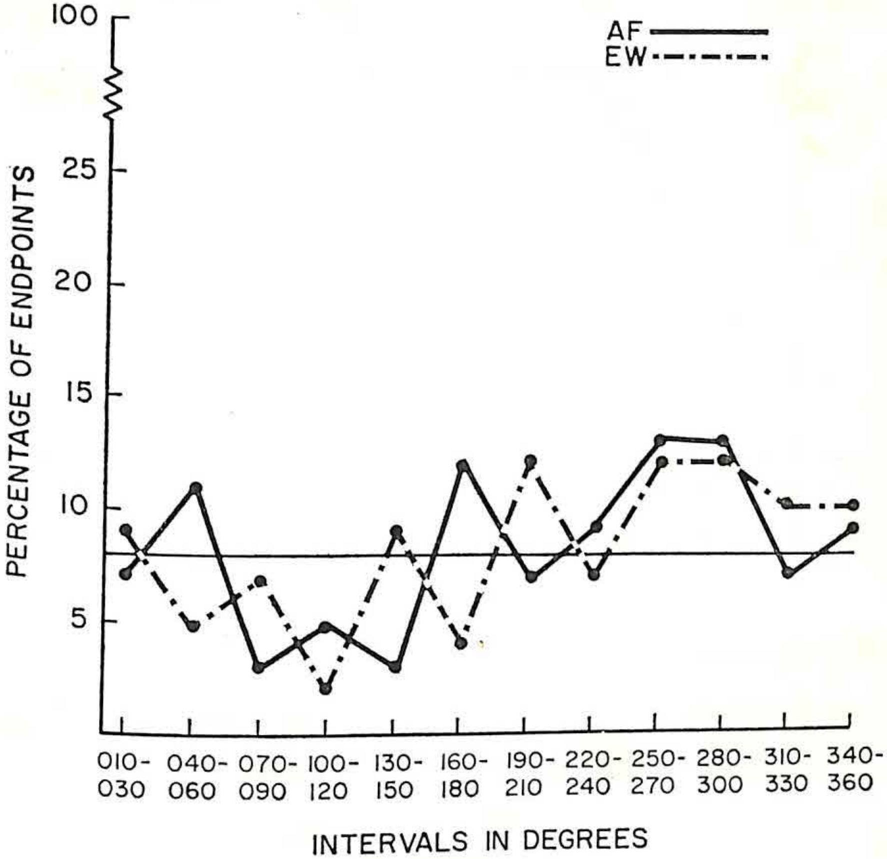

FIGURE 3
Distribution of Endpoints by 10° Intervals for AF and EW Field Conditions
Horizontal line indicates distribution under isotropicity ($p = .083$).

It may be seen that the 12-n. distribution was statistically significantly different from the isotropic or random distribution, and that there was a trend toward significance for the 5-p.m. distribution. When χ^2 was utilized to compare the distribution under each condition with the distribution under each other condition, significant differences were found between the 8-a.m. and 12-n. distributions, and between the 12-n. and 5-p.m. distributions ($\chi^2 = 6.47$

and 10.26, respectively; $p = .05$; $df = 2$), but not between the 8-a.m. and 5-p.m. distributions. Figure 4 is a graphic representation of the three time-of-day distributions.

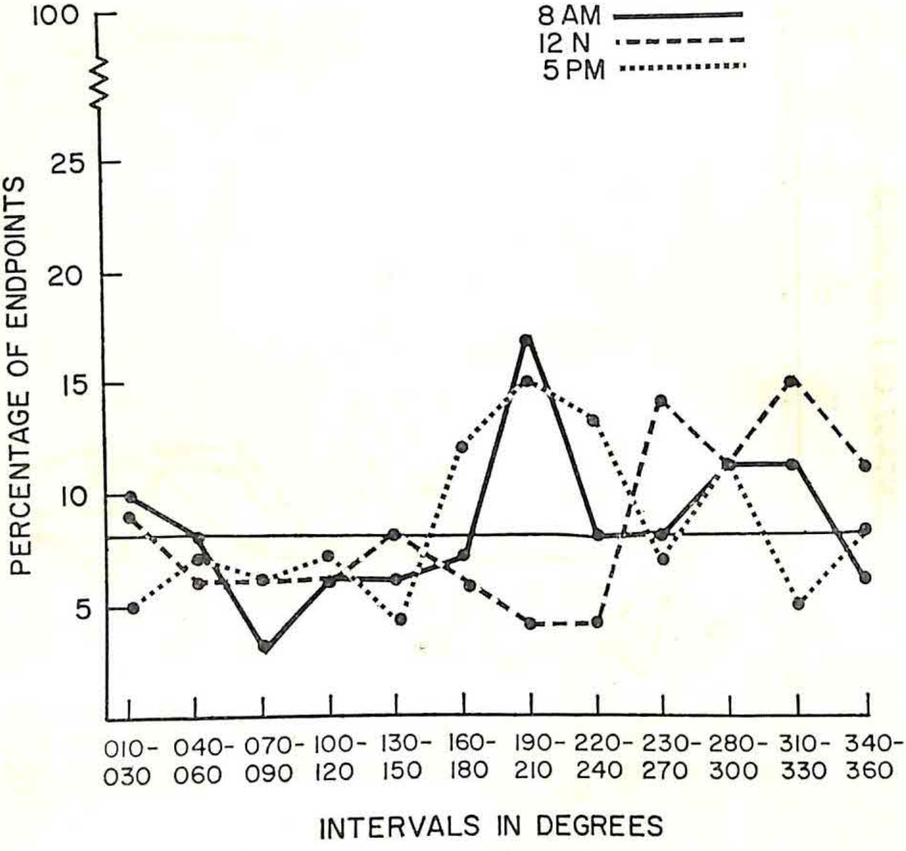

FIGURE 4

Distribution of Endpoints in 10° Intervals for Time-of-Day Conditions
Horizontal line indicates distributions under isotropicity ($p = .083$).

The results of Tukey's test performed on the distributions resulting from the three different times of month can be found in Figure 2. It may be seen that the third week (new moon) has a distribution that differs from the isotropic, and the first week shows a trend in that direction. A χ^2 analysis on these two distributions indicates that they do not differ from each other ($\chi^2 = 3.71$, $df = 3$). Figure 5 shows the first-week and third-week distributions.

The next series of analyses deals with the effects of the various conditions on the activity level of the organism. Chi square was employed to determine whether the various conditions had a significant effect on the activity level.

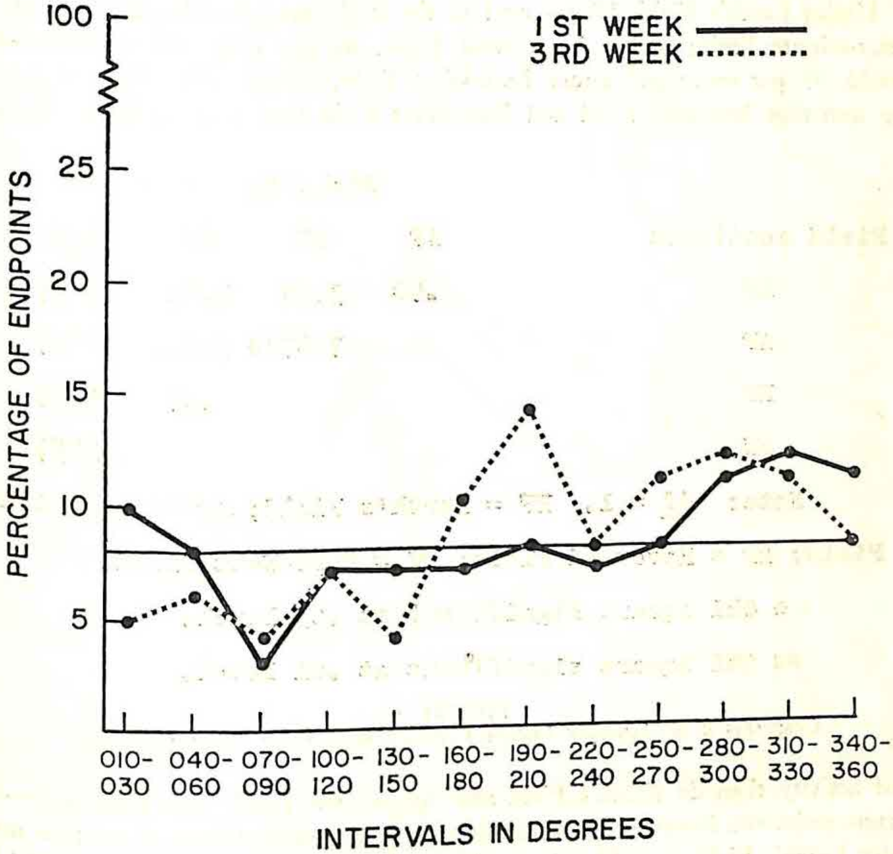

FIGURE 5
DISTRIBUTIONS OF ENDPOINTS IN 10° INTERVALS UNDER 1ST WEEK AND 3RD WEEK TIME-OF-MONTH CONDITIONS
Horizontal line indicates distribution under isotropicity ($p = .083$).

Figure 6 shows the results of the χ^2 analysis on data collected under the different magnetic field conditions.

It may be seen that there is no difference in activity level between Earth's Field and Augmented Field, Earth's Field and East-West Field, or between Reversed Field and East-West Field. However, there is a definite difference between the activity levels produced under the Augmented Field and Reversed Field and under the Augmented Field and East-West Field conditions, and a definite trend towards a difference between the Earth's Field and Reversed Field conditions.

Under Earth's Field, 59 per cent of the trials were completed within the four-minute limit; under Augmented Field, 66 per cent; under Reversed Field, 47 per cent; and under East-West Field, 50 per cent. Thus, it may be seen that Reversed Field and East-West Field tend to yield lower levels of activity than do Earth's Field and Augmented Field. The percentage of runs under the Reversed Field condition was 12 per cent lower than that under Earth's Field, and 19 per cent lower than that under Augmented Field.

	Field condition			
Field condition	AF	RF	EW	(*N*)
EF	.90	3.09	1.81	(120)
AF		7.67**	5.68*	(112)
RF			.07	(115)
EW				(115)

Note: *df* = 1. EF = Earth's Field; AF = Augmented Field; RF = Reversed Field; EW = East-West Field.

* Chi square significant at .05 level.

** Chi square significant at .01 level.

FIGURE 6
COMPARISON OF ACTIVITY LEVELS FOUND UNDER EACH FIELD CONDITION

The effects on activity level of the interaction of magnetic field condition and time of day were next investigated. There was a trend towards a significant difference between the activity levels under each condition only during the 12-n. time period ($\chi^2 = 7.27$, $df = 3$). As was found under the overall analysis above, the Reversed Field and East-West Field conditions contained the smallest percentage of runs, or the lowest activity levels. Figure 7, giving the percentage of runs completed under each condition holding time of day constant, shows this result. The activity level under the Reversed Field condition was from 13 per cent to 25 per cent lower than that under the Augmented

Field condition, and from 7 per cent to 15 per cent lower than that under the control condition, the maximum difference occurring at 12 n.

Further analysis was made to determine whether there was a different activity level under each condition depending on the time of day. Figure 8 shows that within each field condition, the time of day had no differential effect on the activity level. The percentage of completed runs under the Earth's Field condition, for example, was approximately the same for 8 a.m., 12 n., and 5 p.m.

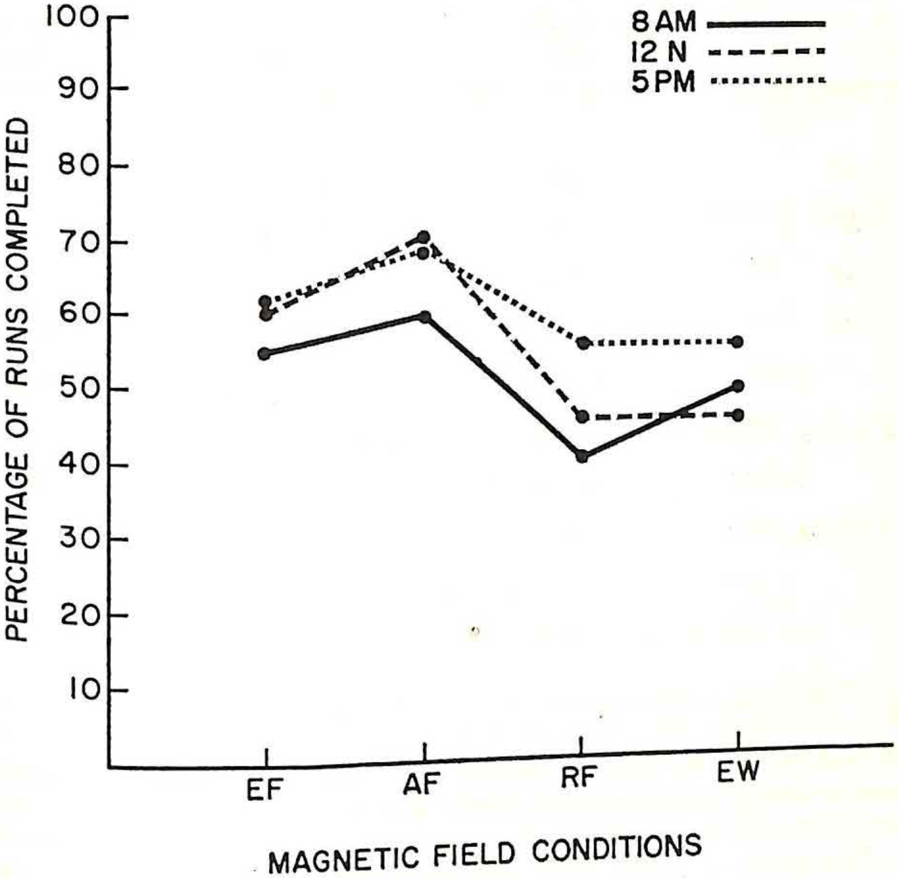

FIGURE 7
Activity Level Under Each Field Condition for the Three Time-of-Day Conditions

The next area to be dealt with is that concerned with the effects of the time of month (or moon phase) on the activity level. Only under the first-week (full moon) condition was there a significant difference in the percentage of runs completed under each magnetic field condition ($\chi^2 = 14.28$, $p = .01$, $df = 3$). Figure 9 gives a graphical representation of the percentage of runs completed under each field condition for each time of month, showing that

Field Condition	χ^2 Across Time of Day conditions	χ^2 Across Time of Month conditions	(N)
EF	.48	15.28**	(120)
AF	.95	2.85	(112)
RF	1.78	6.55*	(115)
EW	.83	3.34	(115)

Note: df = 2. EF = Earth's Field; AF = Augmented Field; RF = Reversed Field; EW = East-West Field.

* Chi square significant at .05.

** Chi square significant at .01.

FIGURE 8
COMPARISON OF ACTIVITY LEVELS WITHIN EACH FIELD CONDITION ACROSS TIME-OF-DAY AND TIME-OF-MONTH CONDITIONS

the third week yielded the greatest total activity. Figure 8 shows the results of analysis on the time of month, holding magnetic field condition constant. Here it may be seen that the EF and RF conditions reflect a difference in activity level depending upon the time of month (phase of moon). Figure 10 shows this material graphically. It is evident that the third week (new moon) had the highest percentage of completed runs under all conditions. In the case of Augmented Field, however, this third week was rivaled by the first week, there being no difference in the percentage of runs completed. In all other conditions, the first week yielded an activity level approximately 25 per cent to 35 per cent lower than that of the third week.

The last analysis performed was that to determine the effects of the interaction of time of day and time of month. The results of the χ^2 analysis on activity level under different times of day, with time of month held constant, show no significant differences. When the data for different times of month, with time of day held constant, are dealt with, however, significant differences do appear. Analysis shows that a significant difference in the activity levels was produced by the time-of-month conditions at both 12 n. and 5 p.m. ($\chi^2 =$ 8.89 and 8.04, respectively; $p = .05$; $df = 2$). It may be seen in Figure 11 that, in every case, the activity level was highest under the third-week condition (new moon), leading one to the conclusion that there is very little interaction between time of day and time of month.

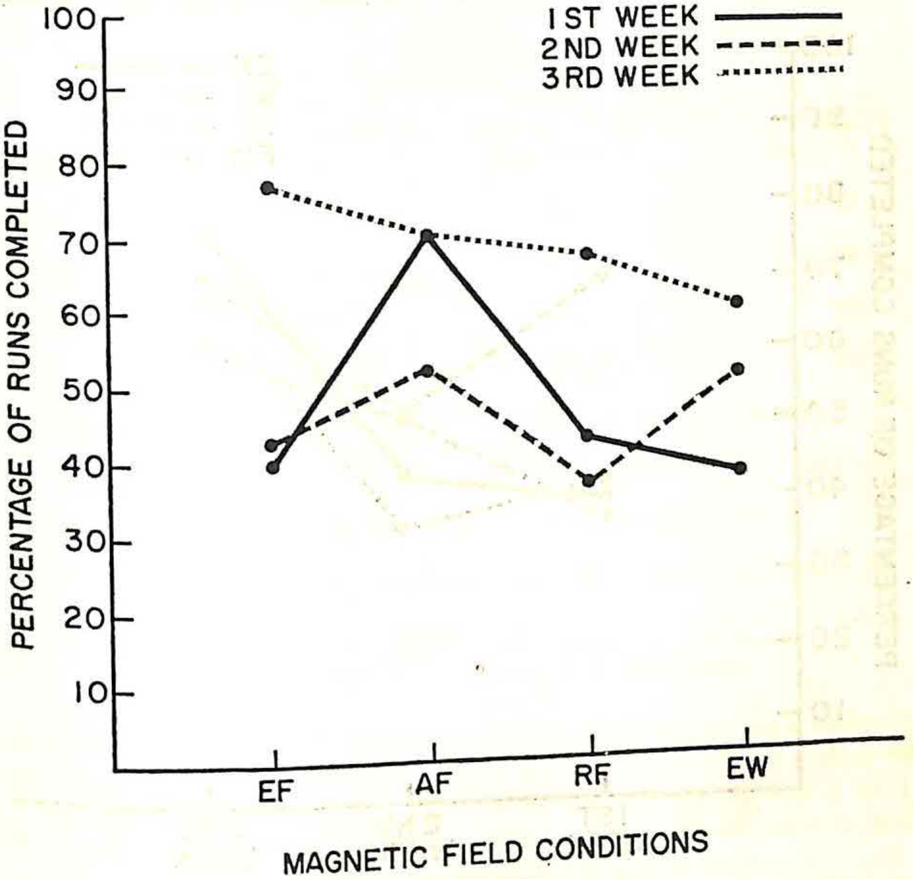

FIGURE 9
ACTIVITY LEVEL UNDER EACH FIELD CONDITION FOR THE THREE TIME-OF-MONTH CONDITIONS

D. Discussion

It is apparent that the magnetic field condition and the time of month (or phase of moon) may have differential effects on the activity level of snails. It is also quite apparent that these two factors, plus time of day, are complexly interrelated, with different activity levels resulting from variations not only in the field conditions, but also in time of day and time of month. It seems likely that the time of month has a greater effect on activity levels produced under different field conditions than does time of day. The interaction between field condition and time of month appears to be much more significant

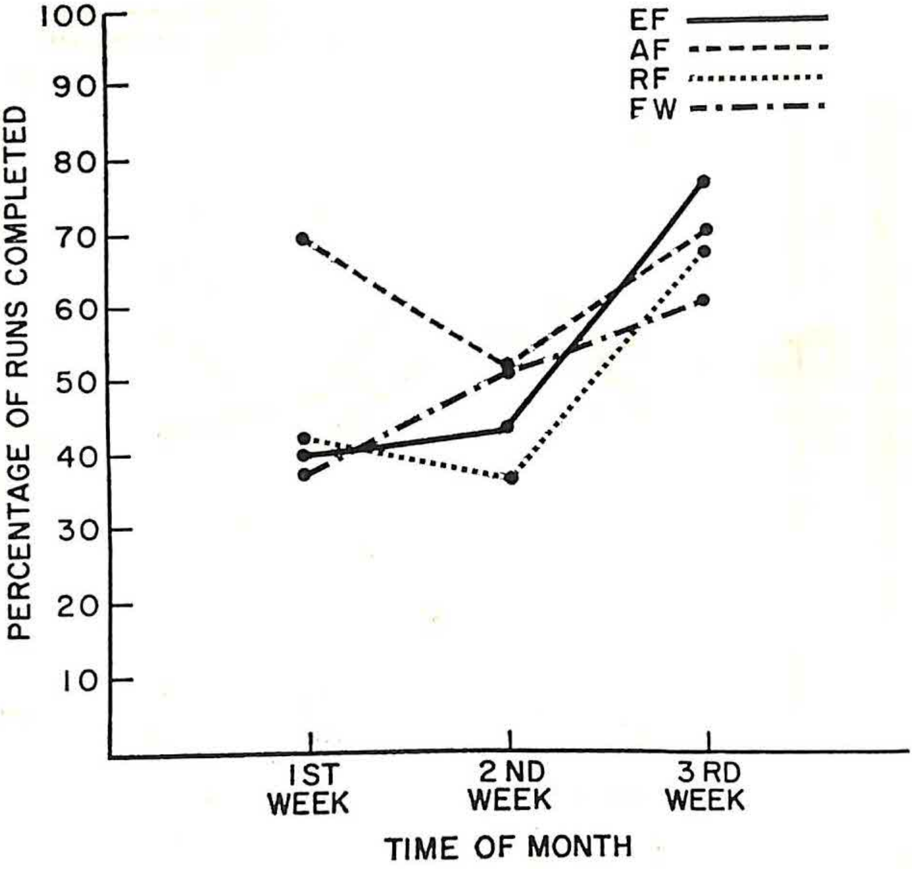

FIGURE 10
Activity Level Under Each Time-of-Month Condition for the Four Field Conditions

than that between field condition and time of day, or that between time of day and time of month. The data suggest that the Augmented Field condition yields the highest activity level, and may act as an excitatory factor. The Reversed Field condition, on the other hand, tends to function as an inhibitor in most cases, since trends in the data show activity levels lower than those under the control condition. It is interesting to note trends in the data that show that under all of the magnetic field conditions, with the exception of Augmented Field, the third-week or new-moon condition yields the highest activity level, and the first-week or full-moon condition the lowest. However,

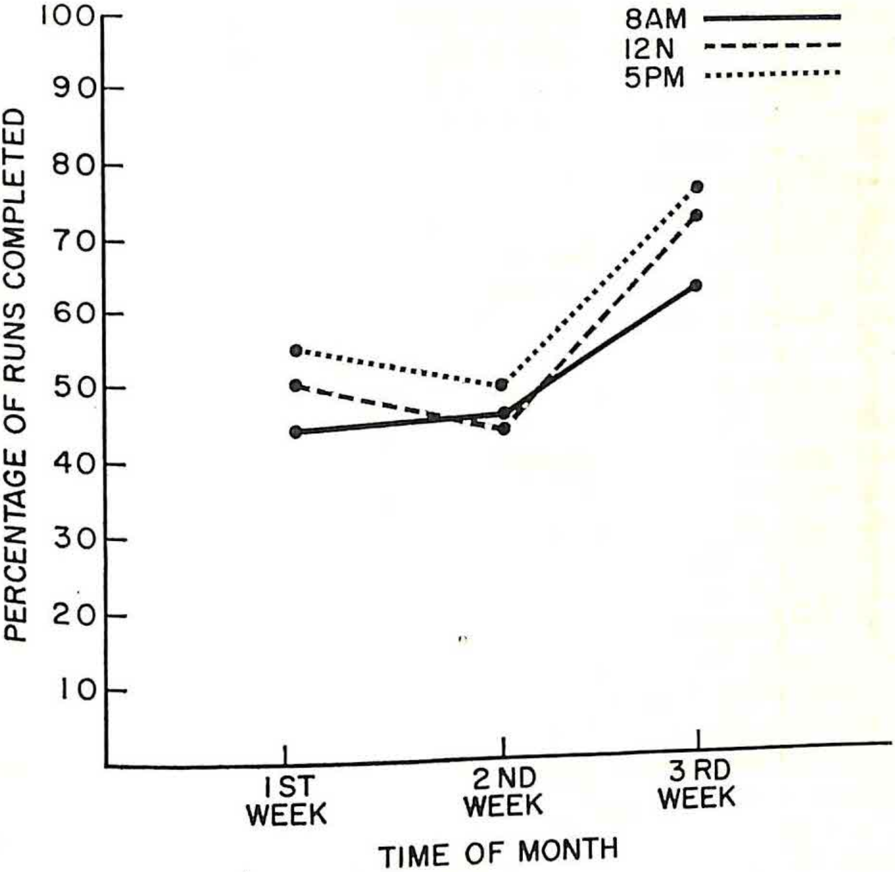

FIGURE 11
Activity Level Under Each Time-of-Month Condition for the Three Time-of-Day Conditions

the activity level under the Augmented Field condition rises during the first week to equal the level under the third-week condition, and is then the second highest of all activity levels. This suggests that the new-moon conditions are simulated by the Augmented Field condition.

The effects of the magnetic field conditions, time of day, and time of month on directional behavior are much less clearcut than are the effects on activity level. Some of the evidence suggests that an influence exists, since one of the time-of-month conditions, and one of the time-of-day conditions yield non-random distributions. Since few of these distributions differ from each other, however, and since there seems to be no definitive changes in direction depending on these conditions, it is difficult to make any precise statements about the effects and mechanisms involved in directional behavior. This is in contrast to the very precise results reported by Brown. It is felt that part of Brown's exactness may have been a function of the very structured methodology that he utilized. It is quite possible that evidence of directional behavior cannot be as precisely delineated when the more naturalistic "whole-compass" technique is used. It would seem that the "whole-compass" technique is a more adequate method than that used by Brown, however, due to the fact that it (*a*) is less cumbersome in studying directional behavior, since all choices of direction are available under one set of experimental conditions; (*b*) is a more sensitive design, since the barriers, which undoubtedly influence the choice of direction, are removed, allowing a more nautralistic and uncontaminated 360°-choice situation; (*c*) provides *S* with more unrestricted space to cover, thus allowing the joint quantification of distance and direction as a more sensitive measure of directional behavior. In subsequent investigations, the "whole-compass" technique should be used in conjunction with Brown's experimental design, which allows the parceling out of effects, in order that more definite and generalized conclusions concerning the compass mechanism and directional behavior might be drawn.

It is quite obvious that additional research needs to be done in this field before effects can be conclusively known and theories and hypotheses developed. Most theories proposed thus far are not adequate to explain the effects due to very weak magnetic fields. Many of the theories dealing with behavioral effects base their arguments on the detection of changes in voltages, temperature gradients, dia- and paramagnetic variations, etc., which require some mediating mechanism, such as conditioning or innate response mechanisms, before the effect could be evidenced. This seems somewhat complicated and on too advanced a level of functioning for the case of the activity-level effects. It is hoped that, through further experimentation, new hypotheses can be formed, which will bring the mechanism down to a purely physical or physiological level—perhaps in terms of changes of the amount of electrical current in the nervous system or in a particular portion of the nervous system.

With the above ends in mind, a number of areas of experimentation are suggested. Further work should be done with time of month and time of day, and their interactions, to determine how these factors might affect the organism similarly to the way in which the organism is affected by the artificial magnetic field. Other environmental factors, such as light, barometric pressure, temperature, humidity, etc., should be studied in conjunction with magnetic field effects and time-of-day and time-of-month effects, since they may be highly related to the latter. The starting direction should be varied in subsequent experiments to determine the effect, if any, of the initial direction of reference to the field. Most important, from an applied and theoretical standpoint, would be the investigation of the effects of varying the strength of the magnetic field. It is quite possible that the differential effects of time of day and time of month, and of the different field conditions are attributable to minute changes in the strength of the magnetic field, which can in some way affect the organism. The first work that should be done in terms of directional behavior is the replication of Brown's experiment with the use of the "whole-compass" technique. If it is still found that directional behavior is influenced by the field and time factors, it would then be important to see if the magnetic field (being the only easily manipulatable factor) could be utilized for informational purposes. Conditioning or learning experiments could be performed with a certain field as the conditioned stimulus or as a constant directional cue which could be used in maze learning. If conditioning is possible, a whole new realm of experimentation will be introduced. It may be possible to determine the exact sensitivity of organisms throughout the phylogenetic scale, and to discover the use various organisms can make of the informational aspects of the magnetic field, and perhaps other little-studied portions of the electromagnetic spectrum.

E. SUMMARY

The behavioral effects of weak magnetic fields, time of day, and time of month were investigated; and subjects were 10 snails (*Helisoma duryi endiscus*) which were run approximately 115 trials under each field condition, resulting in a total of 462 trials under the four conditions. Three times a day for three weeks *S*s were individually run in a 1.5 gauss magnetic field of three different orientations, with the geomagnetic field as the control field condition. Directional behavior and activity level were considered to be indicants of ex-

perimental effects. The "whole-compass" technique was introduced as an improvement in assessment of directional behavior. Statistically significant data reveal that activity level is differentially affected by the magnetic field conditions, by time of month, and by the interactions between field condition, time of month, and time of day. Significant differences in directional behavior were found for one time-of-day and one time-of-month condition. It is apparent, however, that directional-behavior effects are quite subtle and less demonstrable than are activity-level effects.

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THE DEVELOPMENT OF INTENTIONALITY IN MORAL JUDGMENT IN CITY AND KIBBUTZ ADOLESCENTS*[1]

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A. INTRODUCTION

Most research oriented toward Piaget's theory (20) of moral judgment concentrated on the age period of the transition from the use of results (objective responsibility) to intentionality or motives (subjective responsibility): i.e., from six to 10 years. More recently there has been increasing interest in older subjects in this general area (14, 18), and specific data related to the continuously developing use of intentionality have been presented (14, 16).

Interest in the transition as such probably explains the relative lack of development of tools for the refined measurement of the use of intentionality. Most investigators appeared to have been interested in the variation of the independent variables, and used the simple stories originally employed by Piaget, or others quite similar in form. Research from this laboratory has shown that indices of intentionality based on Piaget's stories have already reached their maximum by the age of 11, and are obviously insensitive to any further possible development. Other items directly related to the development of the principle of intentionality in moral judgment were therefore constructed. These items were chosen on the basis of an examination of relevant dimensions of cognitive functioning: e.g., the ability to verbalize the principle used. Use of these indices with an adolescent population (ages 11 - 17) showed a great amount of systematic development all through the age range tested. It is assumed that this cognitive growth is related to that originally examined by Piaget. When this assumption was given, it appeared of interest to examine whether the same independent variables influence the development during adolescence. A number of studies have indicated that the use of intentionality is regularly related to age changes under various sociocultural circumstances (4, 14).

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In attempting to analyze this age linked development, Piaget suggested that the processes involved were influenced by the socialization experiences of the child with influential adults and in his interaction with his peer groups. This socialization experience was loosely conceptualized by Piaget who used such terms as adult constraint and heteronomous respect *vs.* cooperation and mutual respect. Most followers of Piaget concentrated on comparing samples from different cultures or social classes in the hope of uncovering interesting differences in development. A recent review by Boehm and Nass (3) concludes: "findings with regard to social class differences in moral judgment do not point to a consistent picture, although strong trends toward social class differences are apparent" (p. 10). An analysis of the difficulty of studies using "social class" in connection with this problem has already been presented (16). More specifically related to this issue is the fact that parental permissiveness was not found to be related to development on the Piaget dimensions by MacRae (17), and Johnson (11). Most recently, Kohlberg (14) concluded that, while peer group participation (measured by friendship choice) is an important factor associated with general development of moral judgment, it has not been found to be specifically associated with advance on measures of intentionality.

The child-rearing practices prevalent in the Israeli Kibbutz society seemed to provide an opportunity to evaluate Piaget's theory in regard to the socialization independent variables he suggested. Piaget considered the influence of parental authority as an inhibiting factor, and the developing peer group as a positively stimulating influence in the progressive transition from objective to subjective responsibility. The shift of primary influence from the parents to the peers was thought to bring about the sense of mutual respect and cooperation necessary for the occurrence of this transition.

The Kibbutz collective settlements were founded primarily by people who came from Europe, and have continually maintained a high level of Western culture in addition to the particular forms generated in creating a new society in Israel. An analysis of these specific forms suggests that they provide a sort of "supersocialization" in terms of the factors suggested by Piaget, which should lead to accelerated development in the dimension under discussion. Some elements of the pertinent factors are present in what may be called Kibbutz collective education from quite an early age. Various studies by outsiders (6, 10, 21, 22), as well as Kibbutz members themselves (7, 8), describe the peer group as an important socializing agent operating at a very early age. Actually the child becomes part of a peer group right after birth, and grows up as a member of a particular group until they all leave for the army at the age of 18. During early childhood the most important socializing agent is the adult caretaker, but an increasing part of socialization passes over to the group which distributes its own rewards and punishments. Feelings of mutual concern and cooperation in three-year-old children have been observed in such groups (22). Among these the use of the expression "our," "us," and "we" is as frequent as the use of "my," "me," etc. (2).

In addition to very early peer group participation the Kibbutz child is reared with comparatively reduced adult authority. The minimal necessary demands in the case of the small child are made by the caretaker rather than the mother. Later authority becomes divided between the caretaker and the teacher. Corporal punishment is frowned upon in the Kibbutz, and there is relatively little formal pressure to study, with few exams or grades. It would thus appear that adult authority for the Kibbutz child is more diffused, as well as less powerful, in comparison with a child reared in the city.

Given these factors of reduced adult authority and early peer-group-participation functioning within a framework based on the central principle of cooperation, our interpretation of Piaget's formulations would predict earlier and possibly more mature development of the principle of intentionality in the Kibbutz youth.

B. METHOD

The questionnaire included items constructed to test (*a*) whether the subject uses either or possibly both of the principles of results and of intentionality and (*b*) whether he is aware of those principles.

Following is a detailed description of the questionnaire and the definition of the "correct response" for each of its parts[2]:

1. *Part A*

Part A, using intentionality as a crude criterion for judgment, consists of 12 items relating to the same area of actions. Three different levels of intentionality (planning, lack of caution, madness) and four levels of results (death, wound, possible hurt, nothing) were combined so that all the possible variations are given. The subjects are required to judge, on a four-point scale of blame, the degree of blame of a person performing one of the 12 acts. Comparing the degree of blame given to the same intention with different results, and the same results with different intentions, provides us with the degree to which the subject uses intentions or results as his criteria for judgment.

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[2] A full translated description of the questionnaire used appears as an appendix to Kugelmass (15).

"*Correct response.*" If throughout the 12 items the subject never gave higher weight to results than to intentions, this was defined the "correct response" to Part A.

2. *Part B*

In Part B, using intentionality as a refined criterion for judgment, the subject is required to rank all the 12 items of Part A in order of blame. Whereas in Part A the different intentions may be given the same degree of guilt, in Part B the subject has to discriminate between all the components of the items, and rank them with preference to the principle of intentionality.

"*Correct response.*" Perfect ranking of the items according to the intentions of the actors was defined as the "correct response" to Part B.

3. *Part C*

In Part C, recall of the principle of intentionality, the subject is presented with the following act: "One person hurt another person. If you have to judge the actor, what would be the most important question to ask?" The responses are then actually categorized according to whether the intentions are mentioned or not.

"*Correct response.*" If the most important question to ask about the incident is whether the person intended to hurt the second person, this is defined as the "correct response" to Part C.

4. *Part D*

In Part D, recognition of the principle of intentionality, as in Part C, the same act is given and the subject is required to state the two most important questions to ask in order to judge the actor, in their order of importance. However, nine possible "most important questions" are now presented, and the subject has to check his choices. Here, then, we are dealing with the recognition of the principle of intentionality which is presented to the subject.

"*Correct response.*" As in Part C.

5. *Part E*

Whereas in Parts C and D it was sufficient for the subject to label the principle by using the proper words, in this part, verbalization of the principle of intentionality, the subject has to show that he can use the principle in a refined manner and explain exactly what he is doing. Part E consists of two items, E_1 and E_2 of the following structure: An act is given, and four justifications for it are presented. Only one of the justifications relates to the intentionality of the actor. The subjects have to locate the justification that is exceptional, and to explain what it is that makes it exceptional.

"*Correct response*." If the subject checks the proper justification and in his explanation verbalizes comprehensively the principle of intentionality, this is defined as the "correct response" to Part E.

6. *Vocabulary*

Twenty-five words are given, with five possible synonyms, and the subject has to check the proper synonym. The number of proper words checked is the subject's score on the vocabulary test.

C. SUBJECTS AND PROCEDURE

The questionnaire was administered to all of the subjects in our sample in such a way that subjects in the same school were all tested at exactly the same hour so as to avoid contamination through communication. The distribution of the sample tested according to age and type of socialization is presented in Table 1.

TABLE 1
DISTRIBUTION OF THE SAMPLE

Age	City	Kibbutz	Total
11	126	37	163
12	162	94	256
13	261	95	356
14	176	72	248
15	127	69	196
16	93	58	151
17	69	51	120
Total	1014	456	1490

The city sample was obtained from five different schools, which included children ranging from lower to upper middle class. One of these schools was purposely chosen because it had classes extending from the first to the 12th grade, and provides a situation minimizing the selection bias often accompanying the transition from elementary (compulsory) to high school education. Three different Kibbutz schools were obtained through the cooperation of the "Ihud," and "Hakibbutz Hameuchad" movements. Each of these schools serves more than one Kibbutz.

D. Results

Table 2 gives the percentage of "correct responses" to each part of the questionnaire according to age and type of socialization.[3]

Examination of Table 2 shows that the differences between the two samples are minimal. Only five out of a total of 42 comparisons were found significant, all of them in favor of the city. It should also be pointed out that four of these were in later adolescence (ages 16-17), which may merely reflect a sampling problem. Within the Kibbutz schools the dropout in high schools is not as big as in city schools; therefore, in the last grades the average level can be expected to suffer.

TABLE 2
Percentage of "Correct Responses" to Each Part According to Age and Socialization

		Age						
Part	Socialization	11	12	13	14	15	16	17
A	City	62.7	60.2	61.2	61.4	72.4	80.2	84.1
	Kibbutz	48.6	48.9	51.5	68.1	74.6	74.1	84.3
B	City	7.4	13.6	18.0	19.8	38.7	50.6	58.0
	Kibbutz	5.4	9.4	18.7	20.3	32.3	32.7*	54.0
C	City	32.5	41.4	37.3	40.3	54.5	53.8	63.8
	Kibbutz	27.1	28.7*	37.2	40.3	47.8	53.8	41.2*
D	City	43.4	54.4	64.8	59.5	78.3	80.0	83.0
	Kibbutz	46.0	54.6	70.8	67.2	75.4	79.6	65.4*
E_1	City	5.6	1.2	5.0	9.7	14.1	22.2	26.2
	Kibbutz	0.0	0.0	2.9	9.7	11.3	15.5	23.5
E_2	City	4.0	2.4	4.6	8.5	14.2	26.7	33.3
	Kibbutz	5.7	0.0	3.9	11.1	5.6	10.3*	17.6
Vocabulary	City	44.0	56.4	63.2	64.8	71.6	79.2	80.8
	Kibbutz	50.8	58.0	58.8	68.8	72.8	72.4	74.8

* $p_{(t)} < .05$.

In any case, all of the data refute the specific hypothesis proposed by Piaget. The vocabulary score, while age-related, did not differentiate between the two samples. This refutation of the hypothesis cannot be, therefore, easily attributed to differences in intellectual development, which could have countered the expected effect.

When examination is made of the changes in percentages of "correct responses" taking place with age, it is apparent that all the indices used are continuing to develop in a systematic fashion, during the age range studied.

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[3] The data presented in Table 2 have also been plotted as developmental curves, and appear in Kugelmass (15).

E. DISCUSSION

An analysis of the factors proposed by Piaget as responsible for the development of more mature moral judgment suggested the probability of greater development of intentionality in Kibbutz youth. The results of the present study, however, do not support this prediction for the age range tested. As such, they are in line with the results of Kohlberg (14), who failed to find any association between advance in intentionality and a measure of peer group participation. It might be added that parental democracy or permissiveness has also failed to relate systematically to development on the Piaget dimensions (11, 17).

A number of different indices were used and it was possible to note a great deal of development of intentionality without reaching its limit in the age range studied. Probably the most striking overall impression of the results is the remarkable overlap and similarity in the degree and form of this development in the samples drawn from the two different kinds of socialization environments. This finding would offer strong support for Kohlberg (12), Peel (19), and Boehm and Nass (4), who view the child's moral conceptions as age-related.

It should raise questions for Bronfenbrenner (5), whose summary tends to minimize the role of maturational factors beyond the age of five, and suggests that "the child's cognitive resources for moral judgment are more closely associated with social status and other indications of cultural expectation" (p. 7). While the results are certainly not a direct indication of maturational factors as such, they clearly show that this type of *cognitive* development is strongly age-related through adolescence.

It may still be that the socialization variables suggested by Piaget are of importance for the development of moral judgment under certain circumstances: e.g., simple measures of response in younger children. Perhaps they are only necessary up to a certain degree. While seemingly of little differential importance in the two Israeli socialization environments both of which surpassed the necessary minimum, the factors might have been crucial in the Swiss environment of 25 years ago. Bronfenbrenner (5) has discussed a number of issues related to such a consideration.

A more comprehensive approach might consider it worthwhile to reexamine the different behaviors that have been grouped under the general term "moral judgment." Analyses of this sort have been carried out by MacRae (17) and Kohlberg (13). Some of the behaviors, such as intentionality, would appear to be most intimately based on general cognitive structure, and therefore strongly age-linked. Others may be more directly related to socially conditioned motivational systems (1, 9). Most of the behaviors are probably complex resultants of the two sets of forces. Even in the case of the former, however, it is possible that certain social variables could be of marked importance due to the fact that they have direct systematic influence on the particular cognitive structure under discussion. It is suggested, then, that further consideration of the social variables of influence on the development of intentionality focus on the variable's potential links with relevant cognitive development.

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NURSING HOME OR MENTAL HOSPITAL—WHICH IS BETTER FOR THE GERIATRIC MENTAL PATIENT?*[1]

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A. PROBLEM

In 1965, there were 523,000 beds in skilled nursing homes for the extended care of medical patients. Carefully done surveys by Goldfarb and his collaborators (3, 4) revealed that 87 per cent of patients in nursing homes studied showed significant evidence of chronic brain syndrome. In spite of this impressive finding of mental illness in the nursing home population, patients over 65 years of age from mental hospitals were at first excluded from federal-state programs for Medical Aid to the Aged and were, as a result, not admitted in large numbers to nursing homes. Later reevaluation indicated that a great many of these patients improved or recovered sufficiently from their mental illnesses to be cared for adequately in nursing homes. For a large number of mental patients, with no families or homes to return to, who are adjusted to institutional routine and whose psychoses are dormant, the nursing home or home for the aged may be considered as a placement of choice. It offers more comfort, less stigma, and a closer patient-staff relationship than the huge, sprawling state hospital with its overcrowded wards and chronically understaffed professional services.

In one state hospital in Massachusetts alone, over a 42-month period, over 600 patients have gone to nursing homes with a less than 15 per cent return to the hospital during the first six months following placement.

The question has been raised by eminent authorities (1, 4, 5) whether the nursing home is an appropriate community resource for discharged mental patients. The present study was undertaken to provide information relating to this issue. Specifically, a group of patients placed in nursing homes were compared with a group of patients regarded as candidates for placement in nursing homes, but who remained in the hospital, to test the following hypothesis: "Patients in nursing homes and patients in state hospitals con-

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sidered ready for discharge show for an equivalent rating period (30 days and six months following placement) no differences for relative changes in indices of behavior, adjustment, and physical and mental status."

B. PROCEDURE

There were two groups of 23 patients each sampled so that they were matched for age decade, sex, and race: (*a*) Group I, patients evaluated just prior to placement in nursing homes, who were rerated at 30 days and at six months; and (*b*) Group II, patients remaining in the hospital for at least 30 days following the initial rating, who were rerated at 30 days in the hospital and at six months either in the hospital or in the nursing home.

Further comparison for background variables yielded no significant differences in age at admission to hospital, religious affiliation, occupation, socioeconomic position of parents, physical illness, psychiatric treatment, and diagnosis. Differences for type of commitment and length of stay in hospital were found but were not related to the findings.

Eight tests and rating scales were obtained for each patient at three times: (*a*) prior to placement in the nursing home; (*b*) 30 days after placement; and (*c*) six months after placement (or after initial rating if still in the hospital). The instruments were as follows:

1. Mental status exam (21 objective questions measuring orientation, recent and remote memory, and deficits in cognitive functions and speech).

2. Face-Hand Exam for evaluating impairment of mental functioning [Fink, *et al.* (2)].

3. Brief Psychiatric Rating Scale (BPRS) by Overall and Gorham (7), consisting of ratings of 16 psychiatric symptoms and behaviors on 7-point scales and a total score.

4. Inpatient Multidimensional Psychiatric Scale (IMPS) by Lorr, *et al.* (6), consisting of 75 scaled items measuring 10 psychotic syndromes established by repeated factor analyses.

5. Social and Work Interaction Scales devised by Stotsky, *et al.* (9), for rating social interaction and work activity of chronic mental patients.

6. Activities of Daily Living (ADL), a 12-item, four-point rating scale derived from earlier scales (8, 10) for rating self-care with respect to dressing, eating, continence, toileting, bathing, transfer, standing, walking stairs, response to others, personal appearance, social interaction, and orientation.

7. Physical Signs and Symptoms, a 49-item, yes-no schedule designed to obtain symptoms for the following systems of the body: skin, head, respiratory-cardiovascular, gastro-intestinal, genito-urinary, orthopedic, neuromuscular.

8. Night Shift Scale, a measure, using five-point scales, of 22 disturbances in nocturnal behavior most frequently reported by nurses.

For comparison of groups the *t* test was used for Mental Status, Face-Hand, BPRS, IMPS, ADL, and Night Shift Total Score. Chi square was used for Social and Work Interaction and Physical Signs and Symptoms. Differences and relationships at the five per cent level of probability or below were considered significant.

C. FINDINGS

1. *Initial Ratings*

The two groups differ significantly only for three variables out of 35, slightly above chance expectancy. Group II shows significantly more evidence of Perceptual Distortion and Anxious Intrapunitiveness on the IMPS and significantly more Hallucinatory Behavior on the BPRS. For these three variables analysis of covariance was used in studying relative change to partial out effects due to the initial differences between groups.

2. *Short Term Changes*

There are only three significant differences for relative change from initial rating to 30-day rerating: (*a*) time spent working (Social and Work Interaction Scale) $\chi^2 = 7.85$, $p < .01$, *df* 1; (*b*) Physical Signs and Symptoms $\chi^2 = 13.85$, $p < .001$, *df* 1; (*c*) Motor Disturbance (IMPS) $t = 2.38$, $p < .05$.

In all three cases, Group I (in nursing homes) is favored by the change. They show a greater relative increase in time spent working, decrease in physical signs and symptoms, and in manifestations of motor disturbances.

Even though a total of three significant differences out of 35 in the same direction exceeds by two the number expected by chance, one must reckon with the 32 nonsignificant comparisons. The magnitude and direction of the changes for 26 of these favor the group in the nursing home. This is in excess of chance expectation of 16. In general, the findings allow a tentative conclusion that the group in the nursing home fared somewhat better than the group in the hospital. There is no impressive evidence of a clear superiority for nursing homes. It is, however, clear that patients in the nursing home did not fare worse. None died during the 30-day rating period, regarded as crucial, since it is during the first month that the effects of "transplantation shock" are felt in terms of increased physical illness, psychiatric disturbance, and death.

3. *Long Term Changes*

At the end of six months only seven patients from Group II were left in the hospital. These were successfully matched for age decade, sex, race, and diagnosis with seven patients in nursing homes during the same period.

None of the 35 comparisons was significant. In view of the small sample size, judges who knew both members of each pair of patients were asked to make a global rating of relative change over the six-month period. For four of the seven pairs, the patient in the nursing home was rated as being more improved; for two, no difference was recorded; and for one, the patient in nursing home was rated as worse.

Suggestively, the evidence favors the group in the nursing home.

D. DISCUSSION

With the passage of the Medicare Act in 1965 providing for extended care for all aged patients over 65 years of age, it becomes imperative to determine the relative merits of various facilities for the care of geriatric patients with mental illness. While the findings of the present study may be interpreted as favoring the nursing home over the mental hospital as an extended care facility for the class of mental patients considered, the differences are not sufficiently definitive to warrant major policy changes.

Huge numbers of patients are involved. For example, in the Commonwealth of Massachusetts in 1965, out of a total mental hospital population of slightly in excess of 16,000, approximately 6,800 were 65 years of age or older. It, therefore, follows—from the modest findings of this study and the scope of the problem presented by the presence of an aged population in mental hospitals in excess of 40 per cent of the total—that more definitive studies of relative outcome involving large samples of patients from different hospitals should be undertaken to facilitate the making of correct decisions involving hundreds of thousands of patients and millions of dollars.

E. SUMMARY

The nursing home has become the most important community resource for the placement of aged patients from state mental hospitals who have no home to which to return. The present study sought to compare for short- and long-term-course patients sent to nursing homes with patients remaining in the state hospital. For two groups of 23 patients, short-term changes favored the patients in nursing homes. For long-term changes, with a matched-pair sample of 14 patients, the results were less definitive, though still favoring patients in

nursing homes. In view of the huge numbers of patients involved in the transfer from state hospitals to extended care facilities like nursing homes, more definitive studies of relative outcome involving larger samples of patients should be undertaken.

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INTELLIGENCE AND BENDER GESTALT TEST PERFORMANCE OF INSTITUTIONAL AND NONINSTITUTIONAL SCHOOL CHILDREN*

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A. INTRODUCTION

Institutional children have been reported as being not only poor in social skills (9) and retarded in linguistic development (10), but have been seen as displaying a difficulty in organizing stimuli in a meaningful way (3). So far it has not been established whether this latter deficiency is independent of general mental ability or whether it is an additional example of lower intellectual functioning when these individuals are compared to noninstitutional children.

Although the Bender Gestalt (BG) Test has been found to be related to intelligence (2), school readiness, and achievement (5, 7, 8), as well as visual-motor proficiency (4), until the recent development of the Koppitz scoring system (6) there was no widely accepted standardized method of evaluating test results when the measures were based upon the performance of young children. The purpose of the present study is to determine if there is a relationship between BG Test and intelligence test scores for institutional and noninstitutional children, and to determine if there is a difference between these two groups in their visual-motor proficiency, as measured by the BG Test and scored by the Koppitz method, when the effects of general mental ability have been statistically controlled.

B. METHOD

1. *Subjects*

Children of the institutional group were selected from three Catholic child-care homes located in the Boston area. The 15 males with a mean age of 81 months and the 17 females with a mean age of 83 months had been institutionalized from one to three years with a mean deviation of 1.25 years. At the time of testing all of these *S*s were attending first-grade classes. In order of

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frequency, the reasons for institutionalization were mental illness of parents, death of parents, poor home conditions, separation of parents, and abandonment by parents.

The noninstitutional group consisted of 29 male and 40 female first-grade students attending neighboring Catholic parochial schools. The mean age for both the male and female *S*s of this group was 80 months. Only those children who did not have a medical history of visual, auditory, psychomotor, or neurological difficulties were selected as *S*s for both the institutional and noninstitutional groups.

2. *Test Instruments*

The standard nine-figure BG Test was used as the estimate of visual-motor performance. The developmental scoring system devised by Koppitz (6), which has been standardized for children ages 5 to 10, permitted test-score ranges from zero for no errors to 30 for the maximum number of errors.

Intelligence-level estimates were based upon the California Test of Mental Maturity (CTMM) Short Form, 1963 Revision, Level 1. Raw-score performance on the Language and Non-Language Sections of the test, as well as the total test score, were converted into deviation *IQ*s where the population mean is 100 and standard deviation is 16 *IQ* points. Whereas the Language Section samples comprehension of verbal and numerical concepts and represents more academically oriented ability, the Non-Language Section measures the ability to recognize stimuli or to analyze, logically, relationships by means of essentially nonverbal items. The Total *IQ* ranks an individual in his overall mental maturity in relation to others of the same chronological age and predicts how well a student will do in school.

3. *Procedure*

The CTMM was first administered to the *S*s in group sizes ranging from three to 16 children according to the directions in the test manual. After about a one-week interval, the BG Test was administered individually to each *S* according to the standardized directions of Koppitz (6). All of the data for both groups were collected within a one-month period.

Each set of BG drawings was coded immediately after its administration and was then set aside until all of the *S*s were tested. Before scoring by the examiner, the order of the sets of drawings was randomized. In this way the examiner neither knew the *S*'s name nor which group he represented. Also the possible order effect in scoring the records was different than the ordering effect in administering the tests. As a check on the reliability of the scoring procedure, each BG record was scored twice.

C. RESULTS AND DISCUSSION

Since no significant differences were found in the test performance of the male and female children within both the institutional and noninstitutional groups, only group comparisons are reported in the present study. In Table 1 are summarized the means and mean and standard deviations of the Language Section, Non-Language Section, and Total *IQ* scores of the CTMM, as well as the BG Test scores for each group. It may be seen that although the two groups are alike in variabilities, on the basis of the *t*-tests of the differences between the means, the institutional children had significantly lower (.01 level) CTMM and BG Test scores than the noninstitutional children. The discrepancy between the average intelligence level of the institutional children and the high level of the noninstitutional children could probably be accounted for on the basis of the selective practices in accepting children into the parochial-school system, and the social-class differences of the parents of these two groups of children, as well as the constricting effects of institutional life on intellectual performance (3, 9, 10).

TABLE 1
MEAN AND STANDARD DEVIATION OF BENDER GESTALT TEST AND CALIFORNIA TEST OF MENTAL MATURITY FOR INSTITUTIONAL AND NONINSTITUTIONAL CHILDREN AND *t* TESTS OF DIFFERENCES BETWEEN MEANS

	Group				
	Institutional ($N = 32$)		Noninstitutional ($N = 69$)		
Test	Mean	*SD*	Mean	*SD*	*t*
California Test of Mental Maturity					
Language section	94.7	18.2	114.0	16.1	5.38*
Non-language section	96.5	20.6	112.6	17.3	6.01*
Total *IQ*	95.9	19.2	120.4	16.5	6.57*
Bender Gestalt	8.8	3.0	6.6	3.4	3.64*

* $p < .01$.

Table 2 summarizes the three analyses of covariance of the BG Test scores with the effects of Language Section, Non-Language, and Total *IQ* scores removed. On the basis of the initially significant differences in Table 1, and the subsequent insignificant differences in Table 2, it would seem that the poorer BG Test scores of the institutional group could be accounted for by differences in general mental ability rather than the more specific trait of visual-motor proficiency. Thus in future studies, when comparing institutional school children with other groups in BG Test performance, an important variable to control, at least statistically, would be general mental ability.

TABLE 2

ANALYSIS OF COVARIANCE OF BENDER GESTALT TEST PERFORMANCE OF INSTITUTIONAL AND NONINSTITUTIONAL CHILDREN WITH THE EFFECTS OF CALIFORNIA TEST OF MENTAL MATURITY LANGUAGE *IQ*, NON-LANGUAGE *IQ*, AND TOTAL *IQ* REMOVED

		California Test of Mental Maturity					
		Language section *IQ*		Non-language section *IQ*		Total *IQ*	
Source	*df*	Mean square	*F*	Mean square	*F*	Mean square	*F*
Between groups	1	7.10	1.05	8.20	1.30	9.72	1.46
Within groups	98	6.79		6.31		6.88	

As an alternative to a covariance statistical control, one could have performed a person to person match in *IQ* for children in the two groups and then compared their performance on the BG Test. However, it is likely that such a procedure would have been susceptible to the matched-group fallacy (1). This condition occurs when matching is based upon the selection of *S*s from two populations that differ in the measured variable—in this case *IQ*. Upon a second testing, in this case with the BG Test, differences that may appear between the two groups may be due to regression effects, so that the institutional group would tend to get lower scores and the noninstitutional group would tend to get higher scores.

In Table 3 it may be seen that, although significant (.01 level) Pearson *r* correlations were observed between BG Test and CTMM test scores for the institutional group, no such relationships were observed for the noninstitutional group. When it is assumed that the CTMM is valid, such a finding is not consistent with the conclusions of Billingslea (2) that the BG is generally useful in estimating the intelligence of children ranging from 4 to 12 years of age. Although no direct measures of emotional disturbance were obtained for any of the children in this study, the fact that the institutional children were in such an environment is *prima facie* evidence that they lacked some opportunities for adequate personality development. Thus it would seem that the observed outcome supports the suggestion of Tolor and Schulberg (11) that the test is a valid measure of intelligence only when there is at least moderate ego impairment of the children. However, since the mean intelligence level of the noninstitutional group was not only significantly higher than the institutional group, but was high when compared to the normative group, perhaps the more obvious explanation would be that the BG Test is not a valid measure of high intelligence.

TABLE 3
CORRELATION BETWEEN BENDER GESTALT TEST AND CALIFORNIA TEST MATURITY SCORES OF INSTITUTIONAL AND NONINSTITUTIONAL CHILDREN

	Bender Gestalt Test	
California Test of Mental Maturity	Institutional group ($N = 32$)	Noninstitutional group ($N = 69$)
Language section	—.38*	—.22
Non-language section	—.58**	—.18
Total *IQ*	—.54**	—.23

* $p < .05$.
** $p < .01$.

D. SUMMARY

In order to evaluate the differences, as well as relationships, in visual-motor proficiency and intelligence level, 32 institutional and 69 noninstitutional first-grade school children were administered the BG Test and the CTMM. Using the Koppitz method of scoring the Bender, the institutional children were significantly (.01 level) less proficient than the noninstitutional children. However, when intelligence test measures were statistically removed by covariance analysis, no significant differences were found between the groups in their Bender scores. The significant correlations (.01 level) between BG Test and CTMM scores for the institutional, but not for the noninstitutional group, supports the hypothesis that the BG Test is at least a valid measure of intelligence for institutional children.

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A TEST OF THE DISCRIMINATION HYPOTHESIS: UTILIZATION OF RESPONSE-REVERSALS TO TEST RESISTANCE TO EXTINCTION FOR ESCAPE AND INTERMITTENT ESCAPE CONDITIONS*[1]

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A. Introduction

Hunter (2), Estes (1), Sheffield and Temmer (10), Jones (3), Kolstoe, Kleban, and Utecht (6), and Kleban (4) found increased resistance to extinction resulting from aperiodic noxious stimulation schedules as compared to continuous noxious stimulation schedules. The increased resistance to extinction was found for a variety of avoidance, limited avoidance, and intermittent escape procedures both for running and response-reversal responses.

Several theoretical positions have been used to explain Sheffield and Temmer's (10) findings that omissions in noxious stimulation produce increased resistance to extinction. The theories are (*a*) the generalization decrement hypothesis (10), (*b*) the partial reinforcement hypothesis (1, 11), (*c*) the discrimination hypothesis (9), and (*d*) a fear explanation (8).

The experimenter (4) demonstrated nonsignificance among three *shock: no-shock* intermittent escape ratios, a finding that is contrary to a partial reinforcement explanation. To explain these data, the experimenter presented the following experimental hypothesis: Noxious stimulation produces a vigorous running response and a strong accompanying pain-fear reaction. With the occurrence of omissions in noxious stimulation, it is hypothesized that proprioceptive cues indigenous to the running response become conditioned to evoke the fear component of the pain-fear reaction. Resistance to extinction is increased because of the conditioned fear reaction.

This hypothesis was utilized to design experiments to test the other positions. In Experiment III (5), a study was conducted which tested one of the assertions of the generalization decrement hypothesis (Miller's fear explanation, too) that any omissions in noxious stimulation produce increased re-

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sistance to extinction. The basic difference between the latter hypotheses and the experimenter's position is with respect to which stimulus cues become conditioned to produce the increased resistance to extinction. Whereas the experimenter's position stresses the role of stimulus cues indigenous to the running response, the generalization decrement hypothesis and Miller's fear position emphasize the importance of conditioning novel cue patterns to the running response. In Experiment III (5), two types of intermittent escape schedules were presented in which increased resistance to extinction occurred in only one of the intermittent escape conditions. This finding is contrary to both Miller's and the generalization decrement hypothesis positions.

In this experiment, a design is presented to test specifically the discrimination hypothesis. The explanation based on the discrimination hypothesis would be that increased resistance to extinction occurs because the omissions in noxious stimulation make it difficult for the animals to discriminate when the "true" extinction trials have begun. Thus, in this experiment, subjects are exposed to escape and intermittent escape conditions in a spatial discrimination setting using response-reversals as the criterion. On the basis of the experimenter's position, however, there should be no difference between the escape and intermittent escape groups if the subjects can run from a short electric grid, for which stepping forward always produces successful escape from real or potential punishment. Under such conditions, a difference between the escape and intermittent escape groups would be predicted from the discrimination hypothesis, but would not be expected from the experimenter's position.

A secondary problem of the study relates to the response-reversal extinction procedures. Kleban [Experiment Ia (5)] observed that there were no significant differences between escape and intermittent escape conditions on a standard response-reversal extinction procedure. When extinction trials were massed, however, by placing the animals from the maze arms back into the starting box, extinction occurred more rapidly for both the intermittent escape and escape groups, but with greater resistance to extinction occurring in the intermittent escape condition [Experiment II (5)].

In the present experiment, the discrimination hypothesis is tested under three response-reversal extinction procedures: (*a*) a standard extinction procedure, in which animals are returned to their experimental cages before being returned to the starting box for the next trial; (*b*) a massed extinction Condition 1, in which the animals are returned to the starting box for the next trial after a 30-second interval in the maze arm; and (*c*) a massed extinction Condition 2, in which the animals are returned to the starting box for the next trial after less than a five-second interval in the maze arms. It was predicted that there would be significant differences among the three response-reversal extinction conditions: standard extinction condition > massed extinction Condition 1 > massed extinction Condition 2.

B. METHOD

1. *Subjects*

The subjects were 90 Sprague-Dawley albino rats purchased from the Huntingdon Farms, Conshohocken, Pennsylvania. They were 60-100 days of age at the start of the experiment.

Of the 103 rats that were available for use in the experiment, 13 were eliminated because they had not formed a stereotyped position response by the 20th shock trial. The decision to eliminate these 13 rats was made prior to the experimental run. It was known that a percentage of rats would not establish stereotyped position responses by 20 shock trials, but that they would establish position stereotypes by 40 shock trials (5). It was also known that under the present experimental conditions, resistance to extinction would not be increased or reduced by the greater number of shock trials (5). On this basis, the decision was made to eliminate these rats rather than to lengthen the experimental procedure to 40 shock trials.

2. *Apparatus*

The apparatus consisted of a closed Y-maze with a stem (starting box) extending six inches to the choice-point. The grid floor was placed only in the starting box and consisted of ⅛-inch brass rods placed ½-inch apart. The maze was constructed with wood and painted flat black in the starting box and white in the arms. Guillotine doors were placed at the entrances to the starting box and the choice-point. The guillotine door at the entrance to the choice-point was "T" shaped, which served to prevent retracing to the stem and the maze arms when it was in a closed position. The entire top surface of the maze was covered with removable Plexiglas panels.

The electric shock-inducing apparatus consisted of a zero- to 135-v Variac wired to a 110- to 500- v step-up transformer with a 220,000-ohm, 1w, fixed resistor. The brass rods making up the grid were connected to two leads, every other rod being positive with intervening rods negative. The shock apparatus was controlled by a single-pole, double-throw (off-on) switch. Without a subject on the grid, the circuit produced a 2.5 ma current.

3. *Procedure*

The subjects were not maintained on any type of deprivation schedule and had access to unlimited supplies of food and water. Subjects were run through pretraining, shock training, and extinction on the same day. They were run in groups of three. The pretraining procedure consisted only of a 10-minute interval of free exploration in the maze. The subjects were then returned to the experimental cages for a five-minute interval before the beginning of the training procedure.

The training trials were composed of two noxious stimulation schedules. Forty-five subjects received 20 trials of escape training; the other 45 subjects received intermittent escape training in which electric shocks were administered only on Trials 1, 2, 4, 6, 8, 11, 13, 14, 17, 19. Trials 3, 5, 7, 9, 10, 12, 15, 16, 18, and 20 were nonshock trials.

The first shock trial for the escape and intermittent escape conditions was at a low intensity level to help the subjects establish an escape response on the first trial. The remaining shock trials were all at the outlined high intensities.

On the shock trials, the grid was electrified with the opening of the starting box guillotine door. Once the subject committed itself to a maze arm, the T shaped guillotine door was closed to prevent retracing. Thirty seconds elapsed before the subjects were removed from the maze and returned to their running cages. During the escape and intermittent escape training trials, the subjects were allowed at least a one-minute interval between any two consecutive training trials. Subjects were run consecutively until they completed the 20 training trials.

The measure of response stereotypy was 10 consecutive position responses. Some subjects had started but not fulfilled the position stereotypy criterion by the 20th trial. They were continued on their respective escape or intermittent escape schedules beyond the 20 trials until they fulfilled the criterion of 10 consecutive trials. The 13 subjects that were still vacillating in their position responses by the 20th trial were eliminated from the experiment.

A five-minute time interval preceded the introduction of the response-reversal extinction trials. During the extinction trials electric shock was terminated. A single reversal from the position response was considered the criterion of extinction. The subjects were run until they reached extinction. They were run under one of three response-reversal extinction procedures, 30 subjects to each group: the standard extinction condition, the massed extinction Condition 1, and massed extinction Condition 2.

In the standard extinction condition, after 30 seconds, the subjects were removed from their maze arms and returned to their running cages for at least a one-minute interval. They were run in succession until they each reached the criterion of extinction. In the massed extinction Condition 1, the subjects were run on a massed schedule, one at a time until the response-reversals occurred. These subjects were returned directly to the starting box after a 30-second interval in the maze arms. In the massed extinction Condition 2, the subjects were removed from the maze arms immediately: that is, in less than five seconds they were back in the starting box. As in the massed extinction Condition 1, the subjects were run one at a time until they each reached extinction. If subjects in any of the three extinction groups had not reached extinction by Trial 40, they were placed thereafter on the conditions of massed extinction Condition 2 and maintained on that schedule until extinction occurred.

C. RESULTS

The data were analyzed by a 3 × 2 analysis of variance. The main effects included comparisons of differences between the escape and intermittent escape conditions and the three response-reversal extinction procedures. By the reasoning outlined for both the discrimination and generalization decrement hypothesis, an increased resistance to extinction should occur for the intermittent escape group. The F ratio for one and 84 degrees of freedom was .6500, which is clearly a nonsignificant figure, indicating the absence of any reliable difference between the escape and intermittent escape conditions. A nonsignificant interaction F-ratio, .6523, 2/84 degrees of freedom, indicates, furthermore, that the nonsignificant differences between the intermittent escape and escape conditions held for comparisons among the different response-reversal extinction conditions.

The F-ratio for the three extinction procedures was 9.17, 2/84 degrees of freedom, which is significant at the .001 level. Significant findings were anticipated from the results of Experiment II (5). The information sought in this experiment was whether the massed extinction Condition 2 would produce significantly quicker response-reversals than the massed extinction Condition 1. The mean values for the response-reversal extinction scores were respectively 22.90 (standard extinction condition), 16.53 (massed extinction Condition 1), and 7.80 (massed extinction Condition 2). The t ratios, one-tailed test, were respectively 2.43, 4.28, 1.84 for the *standard extinction:massed extinction Condition 1; standard extinction:massed extinction Condition 2;* and *massed extinction Condition 1:massed extinction Condition 2.* These t ratios are significant at the .001, .001, and .05 levels, indicating that resistance to extinction is very much related to these massed extinction procedures.

When comparison was made of the response-reversal scores for the escape groups in the present experiment and for Experiment II, massed extinction condition (5), higher extinction scores were noted for the 6-inch grid as compared to the 20-inch grid. With the exception of the length of the grids, the two groups were run under identical experimental conditions. The mean response-reversal scores were 5.00 for the 20-inch grid and 20.06 for the 6-inch grid. The Mann-Whitney U test score was 44.5 ($N_1 = 15; N_2 = 15$), which is significant at the .01 level, indicating a lower response-reversal extinction score for the longer electric grid.

There were also significant differences present between the 6-inch and the 20-inch grids with respect to the acquisition of stereotyped responses. The mean number of trials for establishing a stereotyped position response was 7.62 trials for the 6-inch grid and 4.50 trials for the 20-inch grid. A *t* ratio for 148 degrees of freedom was 3.22, which is significant at the .01 level. The 20-inch grid acts to facilitate stereotypy more quickly than the shorter 6-inch grid. In line with these results, 47 per cent of the animals subject to the 20-inch grid became stereotyped on their first running trial. Twenty-three per cent of the animals trained on the 6-inch grid showed the same type of first trial stereotypy. A *t* ratio of 2.97, 148 degrees of freedom, was significant at the .01 level. These results indicate that the longer grid also acts to stereotype position responses at a faster rate than a shorter grid.

D. Discussion

There have been a number of theoretical positions advanced to explain how omissions in noxious stimulation produce increased resistance to extinction. All of these positions are based on very limited data with respect to aversive conditioning, and several of them represent direct extrapolations from data accumulated with respect to reward learning. The partial reinforcement hypothesis, which can explain the findings of Hunter (2), Estes (1), Sheffield and Temmer (10), and Kolstoe, Kleban, and Utecht (6) did not receive support from Kleban's experiment (4), in which no significant differences were demonstrated among groups receiving 1/5-, 1/2-, and 4/5-*shock:no-shock* intermittent escape ratios.

In the latter paper, the experimenter presented a fear hypothesis to explain how omissions in noxious stimulation act to produce increased resistance to extinction for running and response-reversal responses. He posited that the proprioceptive cues produced by the running response itself become conditioned to the fear component of the pain-fear reaction. During the omissions in noxious stimulation, the fear component of the pain-fear reaction becomes associated and conditioned to the proprioceptive cues produced by the running response.

In contrast, in the generalization decrement hypothesis (10) and Miller's fear explanation (8), the omissions in noxious stimulation are posited to allow novel cues (those cue patterns that are more characteristic of extinction rather than acquisition trials) to become conditioned to produce the running response. Thus, when the extinction trials begin, the appearance of the normal extinction trial behaviors and their cue patterns, which are usually inhibitory of running, act, instead, to motivate and maintain the running response.

The generalization decrement hypothesis and Miller's position, too, can readily explain the previous data on omissions in noxious stimulation (1, 2, 3, 6, 10) and the data that provided difficulty for the partial reinforcement explanation (4). In Experiment III (5), the experimenter tested the assertion of the generalization decrement hypothesis that any omissions in noxious stimulation produce increased resistance to extinction. This position had empirical support from Jones' (3) findings that avoidance, intermittent escape, and limited avoidance conditions produce equivalent increases in resistance to extinction despite the percentage differences in omission trials for the three shock conditions. In Experiment III (5), the experimenter utilized two intermittent escape schedules with omissions occurring on Trials 3, 5, 6, 8, and 10 in the first group and on Trials 11, 13, 15, 16, 19, 21, 23, and 24 in the second group. Under these intermittent escape conditions, increased resistance to extinction occurred only in the group experiencing omissions toward the end of the shock schedule. As a result of these findings, it seems quite clear that any omissions in noxious stimulation do not necessarily produce increased resistance to extinction.

The above findings support the discrimination hypothesis more clearly than any other position, despite the fact that the experiment was designed with respect to the experimenter's outlined theoretical position. The consistency or inconsistency of shock schedules prior to the introduction of extinction trials appears very important in determining resistance to extinction.

The present experiment offered a direct test of the discrimination hypothesis. The results of the experiment did not support the discrimination hypothesis. The intermittent escape and escape conditions provided clearly different consistency-inconsistency experiences of noxious stimulation to the two groups of subjects. Nevertheless, unlike the findings of all previous experiments, increased resistance to extinction was not found for the intermittent escape group. The findings of the present experiment, moreover, lend some confirmation for the experimenter's hypothesis that the conditioning of fear to proprioceptive cues indigenous to the running response maintains the position-response stereotypy in the absence of noxious stimulation. These results, also, cannot be explained by the generalization decrement hypothesis or Miller's fear explanation.

As reported in the "Results" section, the length of the electric grid appears to be of some significance in determining the acquisition and the extinction of stereotyped position responses. With the longer grid, the acquisition of the stereotyped position response occurs more readily than with a short grid. In fact, a higher percentage of animals on the longer grid became stereotyped on their first response runs than the animals that were trained on the shorter electric grid. Despite this greater tendency to form faster stereotypes on the longer grid, the comparison of the escape conditions under the massed extinction Condition 1 for the 6-inch and 20-inch grids suggests that the longer grid may, in part, act to lessen the tenacity of the position stereotypy. Subjects may become hesitant of stepping forward into pain, despite the fact that they are being driven to run at asymptotic speed levels by the electric shock. This observation with respect to the escape groups on the 6-inch and 20-inch grids suggests clearly that as long as the subjects do not have to step into pain, escape procedures are as effective as omissions in noxious stimulation procedures in maintaining strong response stereotypes. The experimenter would guess that the weakening of an escape response would be more related to the conflict developed about running into pain rather than to the inconsistency or consistency of the shock trials.

The time distribution of extinction trials appears extremely important in determining the level of resistance to extinction in the present type of aversive, spatial discrimination problem. In Experiment Ia (5), no differences were found for the standard extinction procedure between the intermittent escape and escape conditions. Both of these conditions, moreover, were demonstrating maximum levels of resistance to extinction. Under the massed extinction Condition 1 procedure [Experiment II (5)], a significant difference was found in favor of greater resistance to extinction for the intermittent escape group. Thus, it became apparent that the nonsignificant result found between the intermittent escape and the escape groups was related directly to the standard extinction procedure and not to the intermittent escape omission schedule.

These findings suggested rather strongly that a fractional anticipatory punishment response (7) might indeed be introduced by the massing of extinction trials. Martin's thinking with respect to fractional anticipatory punishment responses was applied to help explain the Kolstoe, Kleban, and Utecht (6), Kleban (4), and Kleban (5) data. In the Kolstoe, *et al.* (6) and Kleban

(4) experiments, a conditioned fractional, anticipatory frustration response to the absence of food was postulated to motivate the response-reversals. In Experiment II (5), the close temporal relationship between the maze arms and the starting box was posited to stimulate a fractional anticipatory aversive reaction to the cues of the maze arms, thereby motivating the response-reversals. The same results were found in the present experiment, with the added information presented that immediate placement back in the starting box, massed extinction Condition 2, produces more rapid response-reversals than placement in the starting box after a 30-second interval in the maze arms. As explained by Kleban (5), the effects of massing extinction trials or removing a strongly motivating reward are to produce fractional, anticipatory aversion reactions, which consequently result in response-reversals because of a developing avoidance-avoidance conflict between the fear of the grid and the developing aversion of the frequented maze arm.

E. Summary

Increased resistance to extinction is found under conditions of omissions in noxious stimulation. One type of explanation, the discrimination hypothesis, attributes the increased resistance to extinction to the animal's inability to discriminate acquisition trials from extinction trials. This experiment represents a test of the discrimination hypothesis under three conditions of extinction.

Ninety subjects were divided equally between intermittent escape and escape conditions in a Y-maze in which a 6-inch grid was the floor of the starting box. The starting box led directly to the choice-point. The subjects were coerced by the shock trials to adopt a stereotyped position response. They were exposed to 20 intermittent escape or escape trials, and the definition of response stereotypy was 10 consecutive position responses. Subjects were assigned then to three extinction conditions which differed with respect to the massing of the extinction trials. Extinction was defined as a reversal from the position response to the opposite maze arm.

The findings were (*a*) no differences between the intermittent escape and escape groups, a finding which is contrary to the discrimination hypothesis; (*b*) as predicted, significant differences were found among the extinction conditions; (*c*) in comparing across experiments, a greater degree of resistance to extinction was found for escape animals trained on the 6-inch grid in comparison to escape animals trained on a 20-inch grid; and (*d*) a faster rate of position response stereotypy was observed for animals trained on the 20-inch grid as compared to animals trained on the 6-inch grid.

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THE EFFECT OF AGE AND FOOD DEPRIVATION UPON THE GENERAL ACTIVITY OF THE RAT*[1]

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A. INTRODUCTION

The purpose of the present experiment was to examine further the generalization that increments in the general activity of rats under 48-hour food deprivation are less pronounced and are slower to occur with increasing age of *S*. Finger (4), using stationary cages equipped with an infrared beam, found activity increases in 30-day-old rats ranging from 100 per cent to 250 per cent of baseline. Campbell, Teghtsoonian, and Williams (2) and Campbell and Cicala (1) noted similar increases in the tilt-cage activity of rats whose age varied from 23 to 100 days. However, in all age groups except the 100-day *S*s, the increases were smaller and had longer latencies with advancing age. The 100-day *S*s actually showed a decline relative to baseline activity during both 48- and 72-hour deprivation. On the other hand, Weasner, Finger, and Reid (9) obtained a 25 per cent increase in the activity of 125-day-old rats subjected to 72-hour deprivation in the infrared device. Thus, by employing *S*s of other ages and by the use of a different measuring device, the present experiment sought to reexamine the relationship between age and activity and to suggest some reasons for the discrepancy in the results of Finger and Campbell.

B. METHOD

1. *Subjects*

The *S*s, divided among four age groups, were 60 male rats of the DR strain obtained from Dublin Laboratory Animals. At the start of a 10-day adaptation period, the ages of *S*s were 30, 40, 60, and 365 days. Periodic equipment failures reduced the number of *S*s measured on certain days of the experiment; these instances will be noted in the presentation of the results.

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2. *Apparatus*

A detailed description of the equipment used in this experiment has been presented elsewhere (7); only a brief summary will be given here. The *S*s were housed in individual cages throughout the experiment, each of which was equipped with an ultrasonic measurement device. As *S*s move through the nodes and antinodes of the standing waves provided by the ultrasonic unit, a signal is produced which is led to an integrator device that stores the signal as a charge on a capacitor. When the charge reaches a specified value (as the result of movements by *S*), it discharges and pulses a counter. The number of discharges is proportional to the extent of *S*'s movement. Every five minutes, 24 hours a day, a key-punch control unit interrogates each counter and transfers the number of counts together with channel identification (*S*'s ID number) and a time code to a punched card via an IBM 024 key punch. All 12 channels are interrogated and zeroed within five seconds.

The cages were mounted on a rack and were located in a sound-shielded, light-controlled room, with ambient temperature 74 ± 2° F. White noise of 80 db SPL was present continuously to mask the noise of the key punch in an adjacent room and any other extraneous sounds. Illumination of the experimental chamber was provided by fluorescent lights which were programmed to follow a 12-hour light-dark cycle, with the dark period beginning at 1800 hours.

3. *Procedure*

Only one age group was run at a time. The groups were run in a nonsystematic order over a period of 13 months. Two groups of 30-day *S*s were employed in an attempt to reduce and stabilize the large variability of these *S*s. Upon arrival from the supplier, *S*s were installed in the experimental cages and a 10-day adaptation period was begun. Unlimited access to food and water was provided except during a 48-hour deprivation period when food was not available. The deprivation period began at 1500 hours on the last day of adaptation. Following the deprivation period, food and water were continuously available. Each age group was continued in the recovery phase of the experiment either until the mean activity of the group had returned to the mean baseline level (last five days of adaptation) or for a period of 25 days. Each day food and water supplies were replenished and any necessary adjustments to the equipment were made between 1450 and 1500 hours. Daily weighings of *S*s were not made because there is an abundance of data in the literature showing weight changes as a function of food deprivation and general growth.

C. RESULTS

There were 286 activity scores for each *S* on each of 36 days. These data were analyzed by means of conventional and autocorrelation procedures.

1. *Conventional Analysis*

Although the basic datum was the total activity during a five-minute period, daily totals were employed as the unit of analysis in order to reduce the variability associated with the five-minute scores. The baseline activity of each *S* was obtained by summing the daily totals for the last five days of the adaptation period. Each *S*'s daily activity during the deprivation and recovery phases was expressed as a percentage of the baseline level, with baseline activity set equal to zero per cent. Table 1 presents the means and standard deviations of the percentage daily activity of the four age groups during deprivation and recovery. A plot of the mean percentage scores is given in Figure 1. It can be seen that during deprivation the greatest percentage increase in activity occurred in the 30-day *S*s, with progressively smaller increases occurring in *S*s of increasing age. With exception of the 60-day *S*s, all groups also showed an increase in activity from the first to the second deprivation day. The amount of increase was a function of *S*s' age, the younger *S*s showing the largest increments and the older *S*s the smallest increments.

Table 1 also presents the mean activity of each group for the last hour of each deprivation day. Each entry is based on a last-hour baseline computed for each *S*. No statistical analysis is needed to confirm the dramatic increases in the last-hour activity of all groups. However, the large standard deviations of both the total and last-hour measures indicate that the striking changes are not universal among the *S*s.

Upon their return to *ad libitum* food and water, *S*s' activity decreased (Figure 1), with all groups except the 40-day *S*s eventually falling below baseline. It was thought that the activity of the groups would gradually stabilize around the baseline, but this occurred only in the older *S*s. The activity of the younger *S*s continued to increase during the recovery phase, dipping only briefly to baseline following restoration of food and water. Although not presented here, the data of additional recovery days (seven to 12 in the various groups) continued to show the trends illustrated in Figure 1: the activity of the younger *S*s continued to increase, while that of the older *S*s fluctuated around baseline.

Despite their size, the standard deviations presented in Table 1 tend to parallel the changes noted for the means. With few exceptions standard devia-

TABLE 1
Mean and Standard Deviation of Percentage Daily Activity of Baseline During Deprivation and Recovery

	Group							
	30-day ($n = 23$)[a]		40-day ($n = 12$)[b]		60-day ($n = 12$)[c]		365-day ($n = 10$)[d]	
Day	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
			Baseline					
Mean of last 5 days	.0	24.2	.0	13.8	.0	20.0	.0	25.5
			Deprivation					
1-total	83.1	63.4	61.4	39.2	51.7	35.4	27.2	15.5
1-last hr.	493.5	611.7	280.5	342.2	280.4	286.2	62.4	106.8
2-total	127.1	99.6	76.9	66.8	50.1	35.6	40.9	29.0
2-last hr.	1668.3	2497.7	759.8	925.4	618.6	438.2	237.0	291.9
			Recovery					
1	9.0	48.7	23.8	17.0	27.1	19.1	35.4	24.0
2	14.9	46.3	11.3	17.1	— 4.6	17.6	6.9	9.4
3	13.2	41.6	4.3	18.4	c*	c*	— 6.7	9.5
4	6.2	33.1	5.1	20.2	—16.9	26.1	—11.6	12.3
5	— 7.3	24.8	11.5	19.9	—10.9	16.0	— 8.2	10.1
6	— 8.7	27.1	18.2	22.7	— 9.8	24.9	— 8.5	11.5
7	6.5	34.5	14.6	22.4	—16.8	22.3	— 4.2	10.3
8	12.0	38.5	27.5	24.2	—10.0	13.2	4.6	12.0
9	.0	33.7	33.2	29.4	— 7.0	17.6	— 1.0	11.3
10	20.8	39.0	17.8	46.8	—22.2	26.8	2.8	12.4
11	19.9	41.8	41.7	27.4	—19.2	20.2	15.0	14.7
12	5.3	44.1	41.9	26.1	—18.9	26.6	9.5	18.3
13	15.5	39.1	37.7	27.6	—13.0	19.2	5.2	13.4
14	20.2	59.2	38.8	24.8	— .1	35.9	— 2.6	5.4

[a] On Deprivation Day 1, $n = 24$, on Recovery Day 13, $n = 22$. The values of missing data were estimated for Recovery Days 3, 7, and 8.

[b] On Deprivation Day 2 and Recovery Day 9, $n = 11$.

[c] On Recovery Day 12, $n = 11$.

c* Missing data due to equipment failure.

[d] On Deprivation Day 2 and Recovery Day 1, $n = 11$.

tions are largest in the 30-day group, smallest in the 365-day group, and intermediate in the 40- and 60-day groups.

An examination of the absolute activity scores indicated that the differences among the four groups during deprivation and recovery were similar to those obtained with the percentage scores.

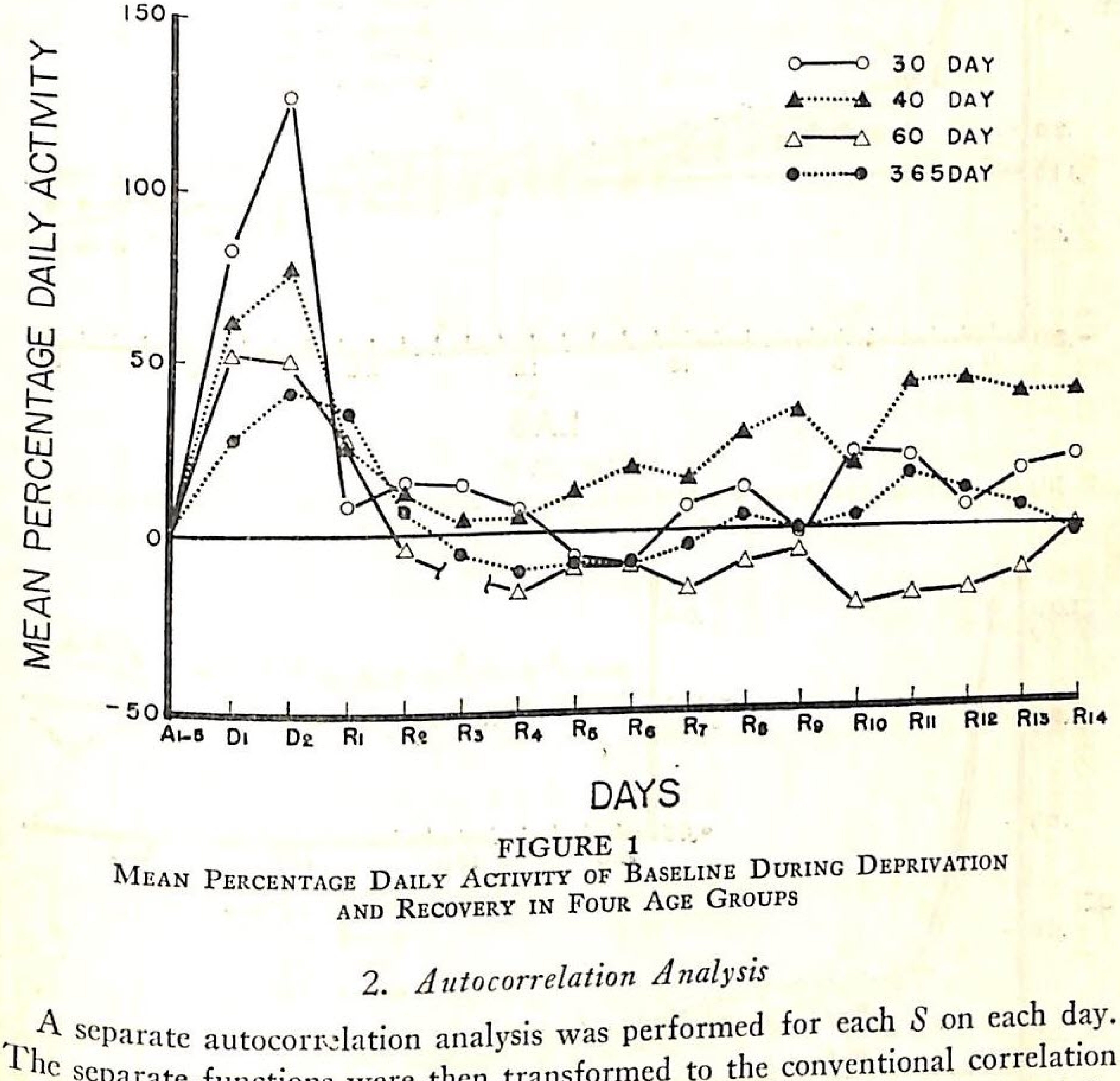

FIGURE 1
Mean Percentage Daily Activity of Baseline During Deprivation and Recovery in Four Age Groups

2. *Autocorrelation Analysis*

A separate autocorrelation analysis was performed for each *S* on each day. The separate functions were then transformed to the conventional correlation scale (—1.00 to +1.00) and averaged over all *S*s. The resulting mean daily autocorrelation functions were further summarized by obtaining a separate mean function for the adaptation (last five days), deprivation (two days), and recovery (14 days) phases of the experiment. These functions are shown in Figures 2, 3, and 4 in which the autocorrelation coefficient (r) is plotted as a function of selected lags. Lag zero represents the correlation of a score with itself, and by definition $r = 1.00$. Lag 1 refers to all adjacent pairs

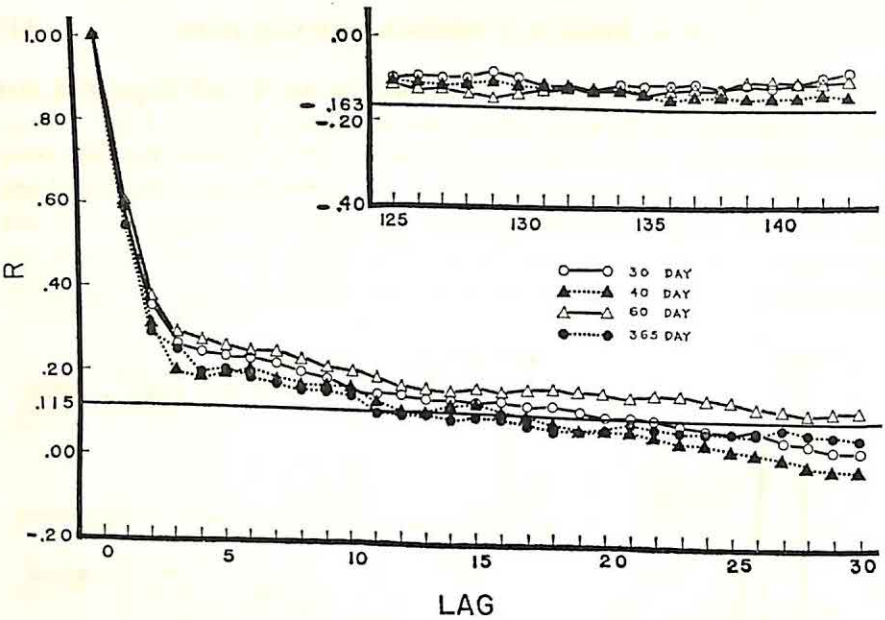

FIGURE 2
MEAN AUTOCORRELATION COEFFICIENT (r) OF FOUR AGE GROUPS AT SELECTED LAGS DURING LAST FIVE DAYS OF ADAPTATION

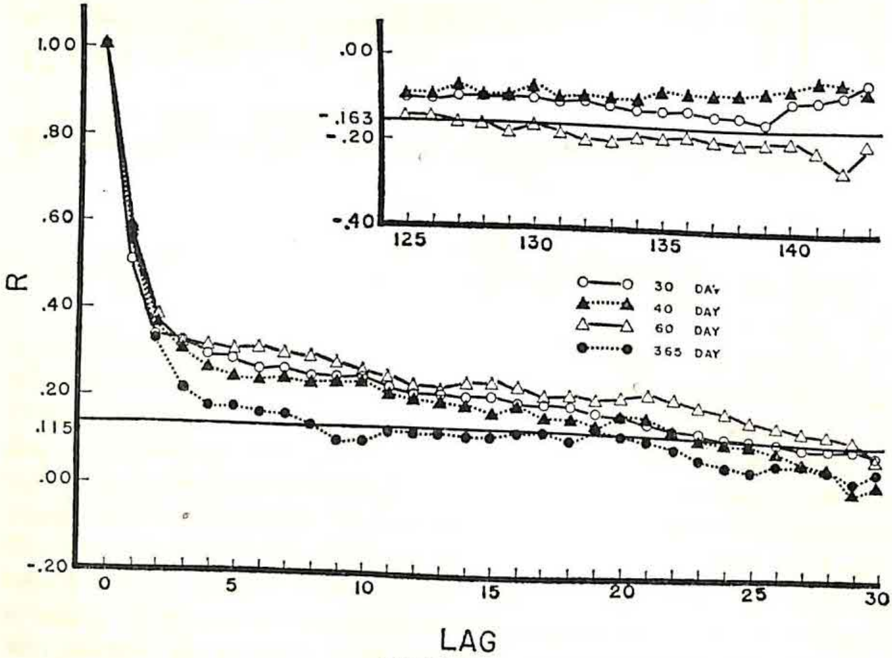

FIGURE 3
MEAN AUTOCORRELATION COEFFICIENT (r) OF FOUR AGE GROUPS AT SELECTED LAGS DURING TWO DAYS OF DEPRIVATION

($N = 285$) of scores throughout the 24-hour period. It will be recalled that each score is based on the total activity in a five-minute interval. Lag 12 represents all pairs ($N = 274$) of scores which are 12 × 5 or 60 minutes apart in a record. Other lags are similarly defined. In all the autocorrelation analyses, an $r \leqslant .115$ at the shorter lags and an $r \leqslant .163$ at the longer lags are not significantly different from zero ($p < .05$). These values of r are only approximate since df decreases by one with each additional lag.

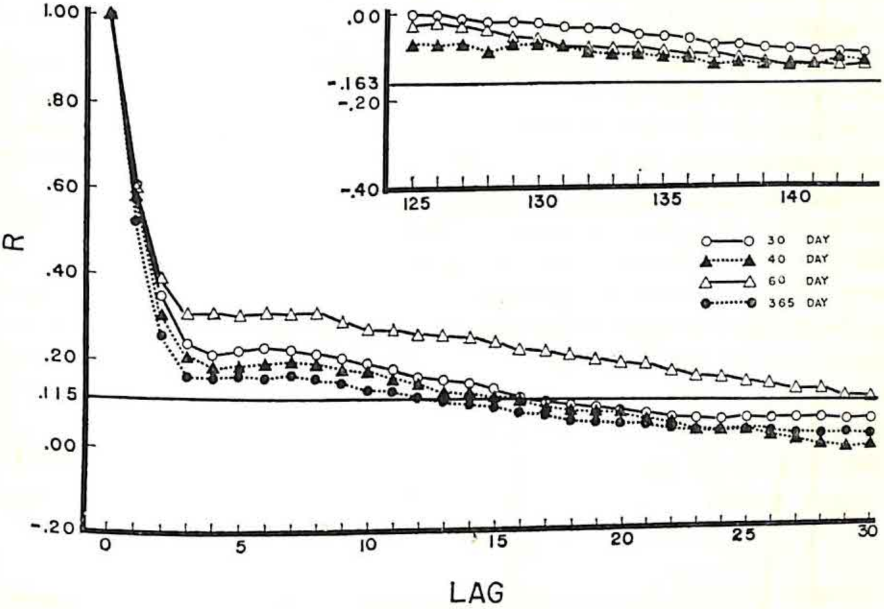

FIGURE 4
MEAN AUTOCORRELATION COEFFICIENT (r) OF FOUR AGE GROUPS AT SELECTED LAGS DURING 14 DAYS OF RECOVERY

In Figure 2 the functions of the four groups show a sharp exponential decay during the first 2-6 lags, followed thereafter by a more gradual decline. It can be seen that the functions become nonsignificant at various lags: Lag 10 for the 30-day *S*s, Lag 11 for the 365-day *S*s, Lag 16 for the 40-day *S*s, and Lag 28 for the 60-day *S*s. This result indicates that the activity scores are positively correlated in multiples of five-minute intervals from five minutes (Lag 1) to 50 minutes (Lag 10) in all groups, from five minutes to 80 minutes (Lag 16) in the 40-day group, and from five minutes to 140 minutes (Lag 28) in the 60-day group. In other words, the activity of all groups is very similar in successive hours during a 24-hour period. In addition, the activity of all groups except the 30- and 365-day *S*s is closely related at 1.5-hour intervals, and the activity of only the 60-day group is related at two-hour intervals. At lags greater than those mentioned above for each group, the functions remained nonsignificant until the maximum lag, 143, was approached. At this point the functions for the 30- and 40-day *S*s approached or became significantly negative ($p < .05$). The autocorrelation function of the 60-day group approached, but never quite reached, the critical value of $r = -.163$. The function for the 365-day *S*s varied little from $r = .00$ once it became nonsignificant at the shorter lags, and, therefore, is not plotted at the longer lags. The significant negative *r*s at the longer lags indicate that *S*s' activity patterns are diurnal.

Similarly detailed interpretations of the deprivation and recovery functions can be made, but only the more important features will be noted. In Figure 3, *r* remains significant until about Lag 24 in all groups except the 365-day *S*s whose function became nonsignificant at Lag 9. A significant *r* at Lag 24 indicates that the activity of the 30-, and 40-, and 60-day *S*s tends to become more vigorous about every two hours. The diurnal pattern is again evident in the 30- and 60-day *S*s (significant 11th- and 12th-hour periods), but not in the 40- and 365-day *S*s. In Figure 4 only the 60-day group shows a significant *r* beyond Lag 14. The activity of the 60-day *S*s tends to heighten approximately every two hours. The *r*s at the longer lags were nonsignificant in all groups, suggesting that a diurnal activity pattern was never established during the recovery period.

D. DISCUSSION

The present experiment clearly supports the generalization that increases in the general activity of rats under 48-hour food deprivation are less pronounced and slower to occur with increasing age of *S*. Both the daily and last-hour measures in the present study showed systematically smaller activity increases with increases in the age of *S*. Furthermore, it appeared that nearly two deprivation days were required for the older *S*s to reach the activity level achieved on the first deprivation day by the younger *S*s. With one exception, these results are in good agreement with those of previous investigations (2, 4, 9). Campbell and his associates have consistently noted that 100-day-old rats do not show increases in activity when subjected to 48-hour food deprivation. In fact, the activity level of these *S*s actually declined during privation. In contrast, Weasner *et al.* (9) and the present experiment found small but definite increases in the activity of the 125- and 365-day-old rats. While 100 days may be a critical age in albino rats, it is more likely that apparatus differences are responsible for the discrepancy. The devices under discussion (infrared beam, tilt cage, and ultrasonic) differ in at least two major ways: the nature of the activity recorded and the nature of the feedback provided by the apparatus. Although there is no way at present of evaluating the comparability of the responses, it seems obvious that the three devices do not measure the same class of activity responses. It is also clear that the proprioceptive feedback of the tilt cage is not present in the infrared or ultrasonic devices. Thus, given these apparatus differences, it is possible that the 100-day-old *S*s in the Campbell experiments ignored or were inhibited by the floor movements of the tilt cages. The tilt cage may measure representative samples of activity in young rats, but it may be quite insensitive to the typical responses of older *S*s. For example, older *S*s probably engage in more sedate activities and avoid the numerous running and jumping responses of younger *S*s. On the other hand, the ultrasonic unit and, to a lesser extent, the infrared device make no distinction among the activities that are recorded.

The systematic changes in the standard deviations, paralleling those of the means, support the general belief that young organisms are quite variable in their behavior. By the time maturity is reached, physiological and behavioral processes have stabilized and the behavior of the cage-reared rat has become relatively stereotyped. However, some environmental changes, such as the absence of food, are still able to elicit strong reactions in mature animals. By way of contrast, young *S*s appear to respond vigorously to all environmental stimuli.

Related to the excessive variability of the young *S*s is the observation that the activity of the 30- and 40-day-old *S*s did not show as strongly the post-deprivation depression found in the activity of the 60- and 365-day-old *S*s. This result was unexpected, since a number of previous investigations (3, 5, 8) have shown that, upon restoration of food and water, activity in running wheels drops and remains below baseline for one to two weeks, depending on the severity of the deprivation. Finger (3) labeled this phenomenon the "satiation syndrome" and demonstrated that activity returns to baseline only when the weight losses accumulated during deprivation have been recovered. It is difficult to reconcile the satiation syndrome with the present results, since the younger *S*s presumably experienced greater percentage weight losses than the older *S*s (2). The present experiment is apparently the first to examine the satiation syndrome with an activity device other than a running wheel. Further research is needed to determine whether apparatus differences can account for the contradictory results on the satiation syndrome, as they do for so many aspects of activity (6).

A previous study (7) with the ultrasonic device showed that only a one-hour periodicity and the usual diurnal cycle were present in the activity of 90-day-old *S*s maintained under *ad libitum* food and water conditions. Autocorrelation analyses of the present data detected 1.5- to two-hour periodicities in the activity of all but the 365-day-old *S*s during the last five days of adaptation and during the deprivation period. The appearance of the somewhat longer periodicities in the younger *S*s is probably related to the large variability of the total daily activity. The diurnal cycle was relatively strong in the young *S*s and relatively weak in the older *S*s during adaptation and deprivation, and it did not appear at all in the analyses of the recovery data. However, an inspection of the individual recovery data indicated that the diurnal pattern was present in *S*s' activity, but its daily occurrence was rather haphazard. A given *S* might follow a diurnal cycle for several days and then respond in a more or less random fashion during succeeding days. In view of the large variability of *S*s' activity, averaging individual autocorrelation functions may hide significant features of the activity of individual *S*s. The present investigators plan to explore further the usefulness of autocorrelation and related techniques in the analysis of activity data.

E. Summary

Four groups of rats, 30, 40, 60, and 365 days of age, were given a 10-day adaptation period and then deprived of food for 48 hours. Food was then restored and activity was recorded continuously until the mean activity of each group had returned to the predeprivational level. The results confirmed the findings of previous investigations that brief food privation produces larger activity increases in younger rats than in older rats. Autocorrelational analyses showed a 1.5- to two-hour activity cycle in all but the 365-day-old *S*s during adaptation and deprivation. During the recovery period, only the 60-day-old *S*s showed a periodicity greater than one hour. Finger's (3) satiation syndrome was observed in the older *S*s but not in the younger *S*s.

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(Manuscripts are printed in the order of final acceptance)

Size of family and behavioral problems in children 151
By Jacob Tuckman and Richard A. Regan

Racial and sexual differences in age of walking: A reanalysis of the Smith *et al.* (1930) data 161
By C. B. Hindley

The Guttman Scale as a means of testing Piaget's Theory of Development . 169
By Sol Kugelmass and Shlomo Breznitz

Behavioral differences between rabbits and cats 171
By Klaus E. Grossmann

Linguistic functions of bilingual Mexican-American children 183
By George B. Linn

(OVER)

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The effect of incentives upon information gathering in diagnostic problem solving 195
By Edith D. Neimark and Nan Lewis

Relationships among attitudes in pregnancy and other maternal characteristics 203
By Barbara A. Doty

Learned reduction of drinking latency 219
By Hans Schmidt, Jr., Alan L. Stewart, and Vernon J. Perez

The effects of temporal variability on the reinforcing properties of visual stimulus change 227
By John W. Donahoe

Six- and ten-year-olds' attribution of punitiveness and nurturance to parents and other adults 233
By Jay Eisenberg, Richard Henderson, William Kuhlmann, and John P. Hill

Effects of previous radiation exposure on the activity response to d-amphetamine hydrochloride 241
By A. A. McDowell, H. H. Ziller, and G. M. Krise

Dimensions of parental practice concerned with cognitive development in the preschool child 245
By Norman E. Freeberg and Donald T. Payne

Infantile shock traumatization and the mitigating effects of tranquilizing drugs 263
By Eugene F. Gauron and Vinton N. Rowley

Conservation of substance in normal and mentally retarded children . . 271
By Carol T. Keasey and Don C. Charles

Psychometric evaluation of an Operation Headstart program 281
By Joyce L. Howard and Walter T. Plant

Auditory perceptual ability of normal children aged five through eight . . 289
By Irene H. Impellizzeri

BOOKS RECENTLY RECEIVED 295

The Journal of Genetic Psychology, 1967, **111**, 151-160.

SIZE OF FAMILY AND BEHAVIORAL PROBLEMS IN CHILDREN*

Division of Mental Health, Philadelphia Department of Public Health

JACOB TUCKMAN AND RICHARD A. REGAN

A. INTRODUCTION

The importance of family size (number of children) for the personal and social development of the individual has only recently been put to empirical test. The earlier consensus of opinion was that children need other children with whom they can associate to learn their first social lessons, and the small family with one or two children does not provide this opportunity (14, p. 84). The only child is liable to "special difficulties of behavior and typical faults of character"; children from larger families benefit from the learning process of give-and-take in social relationships and from mutual support "against the world of grownups" (3, pp. 242-243). Adler stated that the only child has a particularly difficult time adjusting outside the home, where he is no longer the center of attention; only children often come from homes with timid and pessimistic parents who produce an atmosphere full of anxiety from which the child suffers badly (1, pp. 381-382). Bossard and Boll (8) found that persons from families with six or more children agreed that there were desirable influences in the large family. The majority of their 90 subjects felt that there was something in the atmosphere of the large family that tends to promote emotional security even in the face of economic and other difficulties. Support for this view comes from a study by Ellis & Beechley (10) of case records for 1000 child guidance patients. Children from large families (seven or more) were significantly less emotionally disturbed than children from smaller families although the basis for rating the children was not specified. Significant differences remained favoring children from large families when age, sex, and intelligence were controlled. Sewall (17) found that the probability of jealous responses in children decreased as family size increased; Ugurel-Semin (20) found the only child more selfish on the average than those with siblings.

However, in several studies that seem better controlled, the large family was not found to be associated with better emotional and social adjustment.

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Bonney (4, 5, 6, 7), in a series of studies, showed that only children received more than their share of positive sociometric choices; at the college level, individuals with six or more siblings tended to receive less than their share of positive choices. In a study of parent-adolescent adjustment in large and small families (15), Nye found that the smallest families scored highest in adjustment. Differences were large and consistent. When socioeconomic status was controlled (in general, the higher the socioeconomic status, the higher the parent-adolescent adjustment), differences remained significant at the 1 per cent level. Nye's study, however, considered only a small segment of the adjustment relationships of the adolescent. Hawkes, Burchinal, & Gardner (12) used the Rogers personality adjustment test with fifth-grade rural and small town children with one to five or more siblings. They found significantly more favorable relationships with parents and siblings for children from smaller than for those from larger families. For other aspects of adjustment, the differences were not significant, but tended toward better adjustment of smaller families.

The equivocal findings of the empirical studies mentioned above indicate the need for further investigation on the relationship of size of family to personal and social adjustment. The present study, based on a sample of children with behavior difficulties requiring referral to outpatient psychiatric clinics, will furnish data pertinent to the question.

B. Sample and Procedure

From a broader study of children referred to outpatient psychiatric clinics in Philadelphia in 1955 (19), data on size of family by sex, race, and age subgroups were available for 1581 children of a total clinic population of 1813. The full sample was not used because information was not available on race for 119 children; on age, for 36; on family size, for 74, and on several factors, for three children.

Of the 1581 children in the present study, 67 per cent were male, 33 per cent female; 77 per cent white and 23 per cent nonwhite; 15 per cent were under 6 years, 52 per cent from 6 to 11, and 33 per cent from 12 to 17 years. The overrepresentation of boys in the clinic population is a typical finding (2, 11, 16). The whites and nonwhites were represented to about the same extent as the racial distribution in the general population of Philadelphia (Department of Public Health, 1958). Children under age 6 were greatly underrepresented in the clinic population (15 per cent in the clinic and 39 per cent in the general population), those 6 to 11 greatly overrepresented (52 per cent and 34 per cent, respectively), and those between 12 and 17 were slightly overrepresented (33 per cent and 27 per cent, respectively), as shown by the Annual Report of the Philadelphia Department of Public Health (9). Twenty-eight per cent of the children were referred to the clinic by schools; 25 per cent by hospitals and clinics; 17 per cent by private physicians; 17 per cent by parents, relatives, and friends; 7 per cent by health and welfare agencies; and the rest by other sources, such as courts, police, and clergy.

The problems for which the children were referred covered a wide range. In the absence of a standard classification system, the many problems were classified into 12 categories developed by the authors in the earlier study:

1. Anxiety and neurotic symptoms: e.g., fears, nail biting, depression, inferiority feelings, perfectionism, tendency to worry, nightmares.
2. Severe psychiatric symptoms: e.g., bizarre thinking or behavior, conversion symptoms, self-harm, ritualistic behavior.
3. Withdrawal behavior: e.g., daydreaming, passivity, seclusiveness, shyness.
4. School problems: e.g., poor school work, truancy, cheating, school phobia, tardiness.
5. Mental retardation.
6. Aggression: e.g., temper tantrums, disobedience, cruelty, running away from home.
7. Antisocial behavior: e.g., stealing, fire-setting, delinquency.
8. Difficulties in interpersonal relationships: e.g., sibling rivalry, quarrelsome with playmates, "show-off."
9. Somatic symptoms: e.g., convulsions, asthma, overweight, diarrhea.
10. Problems of habit formation: e.g., enuresis, sleep problems, feeding problems.
11. Sexual problems.
12. Miscellaneous: e.g., emotional immaturity, slowness, inattentiveness.

Problem categories and not number of problems within the category were used. For example, a child referred to a clinic because of poor school work, truancy, and cheating in class was counted as one individual with one school problem. The number of problems (categories) ranged from one to eight: one reported in 28 per cent of the cases, two in 34 per cent, three in 24 per cent and four to eight in 14 per cent.

C. RESULTS

The problems for which the children were referred to outpatient psychiatric clinics according to size of family are shown in Table 1. For the total sample, six of the problem categories were related to differences in the size of the family: i.e., number of children. School problems, problems concerning interper-

TABLE 1
SIZE OF FAMILY AND PROBLEMS PRESENTED BY CHILDREN REFERRED TO OUTPATIENT PSYCHIATRIC CLINICS

Family size (number of children)	All children	Sex		Race		Age (years)		
		Male	Female	White	Non-white	Below 6	6-11	12-17
	Distribution of children (N's)							
1	285	187	98	203	82	49	149	87
2	644	431	213	560	84	121	335	188
3, 4	474	312	162	359	115	65	262	147
5, 6	121	88	33	68	53	8	51	62
7 or more	57	35	32	20	37	—	19	38
	Per cent of children in each family size showing problem							
	Anxiety and neurotic symptoms							
1	42	41	44	48	28	35	42	47
2	49	46	54	52	31	46	49	51
3, 4	36	33	41	36	34	28	37	37
5, 6	28	22	45	28	28	38	31	24
7 or more	46	46	45	55	41	—	32	53
	**	**		**			*	**
	Severe psychiatric symptoms							
1	7	7	8	6	11	4	8	8
2	9	8	10	9	10	5	7	14
3, 4	5	4	9	5	5	6	5	6
5, 6	4	5	3	3	6	0	0	8
7 or more	11	3	23	10	11	—	5	13
	School problems							
1	39	45	26	36	45	2	46	47
2	40	45	30	39	48	3	47	51
3, 4	46	52	36	45	52	9	50	56
5, 6	50	52	45	50	51	13	53	53
7 or more	58	63	50	65	54	—	53	61
	*		*	*				
	Aggressive behavior							
1	47	49	43	44	52	49	46	46
2	48	50	43	45	64	50	48	45
3, 4	45	47	39	44	47	42	50	37
5, 6	41	42	36	43	38	25	33	48
7 or more	42	51	27	35	46	—	47	39
					*			
	Antisocial behavior							
1	7	9	4	5	13	0	9	8
2	7	8	5	7	8	0	8	10
3, 4	11	13	9	11	12	2	10	18
5, 6	18	18	18	18	19	0	20	19
7 or more	14	20	5	10	16	—	5	18
	**	*	*	**				

TABLE 1 (*continued*)

Family size (number of children)	All children	Sex		Race		Age (years)		
		Male	Female	White	Non-white	Below 6	6-11	12-17
	Per cent of children in each family size showing problem							
	Withdrawal behavior							
1	9	10	8	11	5	6	7	14
2	14	15	14	15	11	8	15	16
3, 4	15	14	17	16	11	6	15	18
5, 6	9	9	9	9	9	13	10	8
7 or more	14	17	9	15	14	—	5	18
	Somatic symptoms							
1	18	15	24	17	21	14	23	13
2	14	13	15	14	10	14	13	13
3, 4	15	12	21	15	13	18	15	12
5, 6	15	13	21	13	17	0	16	16
7 or more	21	11	36	30	16	—	26	18
	Habit formation							
1	18	18	19	16	23	41	17	7
2	27	25	30	27	21	49	27	12
3, 4	20	20	22	24	10	37	23	10
5, 6	18	14	30	16	21	63	20	11
7 or more	4	3	5	0	5	—	5	3
	**	**	*	**	*			
	Sex problems							
1	4	3	5	4	4	2	3	7
2	2	2	2	2	4	8	1	5
3, 4	4	4	5	4	7	2	2	10
5, 6	4	5	3	3	6	0	2	6
7 or more	5	9	0	15	0	—	0	8
				*				
	Mental retardation							
1	6	4	8	5	7	10	5	3
2	4	2	7	3	10	10	2	3
3, 4	6	5	8	6	7	29	3	1
5, 6	4	3	6	3	6	38	0	3
7 or more	2	3	0	5	0	—	0	3
						**		
	Interpersonal relations							
1	18	16	21	19	13	10	19	18
2	21	23	17	22	14	14	21	24
3, 4	17	17	18	18	15	8	18	21
5, 6	9	10	6	6	13	0	12	8
7 or more	16	14	18	20	14	—	5	21
	*			*				
	Miscellaneous							
1	12	14	8	12	13	10	15	8
2	11	14	7	12	8	14	13	7
3, 4	11	13	9	12	10	6	13	12
5, 6	4	5	3	6	2	0	10	0
7 or more	4	3	5	5	3	—	5	3
	*							*

* χ^2 significant beyond the 5 per cent level.

** χ^2 significant beyond the 1 per cent level.

sonal relationships, and miscellaneous problems were significant beyond the .05 level, while anxiety and neurotic symptoms, antisocial behavior, and problems of habit formation were significant beyond the .01 level. Referrals for severe psychiatric symptoms, aggressive behavior, withdrawal behavior, somatic symptoms, sex problems, and mental retardation were not significantly related to differences in family size. If linearity of trends in interpreting the data is assumed, there was an increase in the percentage of referrals for school problems and antisocial behavior as the size of the family increased; for anxiety and neurotic symptoms, problems of interpersonal relations, and problems of habit formation, there was a decrease in the percentage of referrals as family size increased. However, for problems of interpersonal relations, the trend was so slight and inconsistent that the significant difference may be an artifact of the sample.

Separate analyses were made for sex, race, and age to determine whether these subfactors contributed to the relationship between problem and family size, and are also shown in Table 1. The contribution to the differences was greatest for race, less for sex, and least for age. For the six referral problems which were significantly related to family size, whites contributed to five problems and nonwhites to one; males and females, each to three; 6-11-year-olds to one; and 12-17-year-olds to two problems. The contribution of these subfactors also varied with the referral problem, ranging from four (males, whites, children between 6 and 11, and between 12 and 17 years of age) for anxiety and neurotic symptoms to one (whites) for problems of interpersonal relations. While the contribution of some subfactors was significant and of others was not, which may have been a function of the small number of cases, there was a striking similarity of trends for most of the referral problems.

An analysis of the distribution of size of family in the clinic sample and in the general population showed that only children were underrepresented in the clinic sample. This was evident whether the comparison was based on number of families or on number of children. Using number of families as a base, one-child families were underrepresented (18 per cent in the clinic and 34 per cent of the analogous group with children under age 18 in the general population), while two-child families and those with three or more children were overrepresented (each 41 per cent in the clinic and 33 per cent in the general population) according to census statistics (21). There were race differences: for whites, the respective per cents for the clinic and general population were 17 per cent and 34 per cent, for one-child families, 46 per cent and 34 per cent for two-child families, and 37 per cent and 31 per cent for families with three or more children; for nonwhites, the comparable per cents were 22 per cent and 32 per cent, 23 per cent and 26 per cent, and 55 per cent and 42 per cent. These findings indicate greater overrepresentation of two-child families among whites and greater overrepresentation of families with three or more children among nonwhites, but both whites and nonwhites showed an underrepresentation of one-child families. The age distribution of the head of the family in the clinic sample was not known. However, the difference between the clinic sample and the general population with respect to underrepresentation of one-child families cannot be attributed to differences in age distributions of the head of the family in the two populations. An analysis of the general population, by age of the head of the family, showed a higher percentage of one-child families in every subgroup: 57 per cent for heads under 25 years of age, 27 per cent for those between 25 and 34, 23 per cent for those between 35 and 44, and 47 per cent for those between 45 and 54. For family heads over 55 years of age, the percentages of one-child families increase very sharply. The data for the clinic sample assume that each of the children referred to the clinics represented a single family. This assumption was supported by estimates by the three largest clinics (accounting for over one-half of the children in the sample) that less than 2 per cent of the children referred came from the same family.

For the 1581 children in the sample, there were 2782 siblings, making a total of 4365 children in the families of those referred. Using number of children as a base, only children were underrepresented in the clinic sample (8 per cent in the clinic and 15 per cent in the general population), children from two-child families were represented to the same extent in the clinic as in the general population (30 per cent in each), while children from families with three or more children were overrepresented in the clinic sample (63 per cent in the clinic and 55 per cent in the general population), as shown by the 1960 census (21). It is not possible to make direct comparisons between the clinic sample and the general population regarding the number of related children in the family. Census data provide statistics on related children under age 18 in the family, while the clinic sample may have included an unspecified number of siblings over 18 not living in the home. However, it is most unlikely that any error would be large enough to reverse the finding of underrepresentation of only children. For example, even if 50 per cent of the siblings were living outside the home, the percentage of only children would rise only from 8 per cent to 12 per cent in the clinic sample, which is still below the 15 per cent found for the general population.

D. Discussion and Conclusions

There are two important findings in this study. The first is the underrepresentation of only children in the clinic population. It may be that parents of only children are not able to recognize problem behavior, have a negative attitude toward psychiatry, or do not have an adequate knowledge of community resources dealing with deviant behavior. However, these reasons seem unlikely, since small families are associated with higher socioeconomic status, which suggests that parents of only children have a greater sensitivity to the needs of their children, a better understanding of psychiatry, and a better knowledge of community resources. In fact, higher occupational groups tended to be overrepresented in the total sample from which the subjects in this study were drawn (19); other studies support the finding that higher status groups tend to be overrepresented in the clinic population (13, 16, 18). A more reasonable interpretation of the facts may be simply that only children do not have the problems that have been traditionally attributed to them. Such children may receive greater emotional support from their parents, better physical care, more cultural advantage, less exposure to excessive frustration and competition from siblings. These factors may more than compensate for the lack of opportunity to interact with siblings and to learn the give-and-take in human relationships. The evidence based on sociometric choices suggests that only children are able to get along with their peers at least as well as do children from larger families.

The second finding is the differential contribution of size of family to problems for which children are referred to outpatient psychiatric clinics, which is in line with the apparent inconsistencies of the empirical studies referred to earlier. Some problems are found with greater frequency in smaller families, while others are found more often in larger families. School problems and antisocial behavior increased as family size increased. This suggests that in larger families adequate care and supervision, and the parents' ability to spread love and affection to meet the needs of each child become more and more difficult with mounting household chores, financial worries, and other problems of day-to-day living. On the other hand, as size of family increased, there was a decrease in the proportion of children with anxiety and neurotic symptoms or with problems of habit formation. This may be due in part to greater parental pressure on children to do well and to conform to middle-class standards in smaller families; and in part to more experience in coping with problems, such as eating, sleeping, and elimination in larger families. The differential contribution of family size to behavioral problems suggests that conditions for personality growth and development may be more favorable for some aspects in smaller families and for others in larger families.

E. SUMMARY

A total of 1581 children referred to children's outpatient psychiatric clinics were compared for size of family (only-child, 2-child, 3-or-more-child families) in relation to 12 types of referral problems. Only children were underrepresented in the clinic when compared to the general population; those from families with three or more children were overrepresented. As family size increased, school problems and antisocial behavior increased, while anxiety and neurotic behavior and problems involving habit formation decreased. Figures are presented for analysis of subgroups based on sex, race, and three age groups.

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RACIAL AND SEXUAL DIFFERENCES IN AGE OF WALKING: A REANALYSIS OF THE SMITH *ET AL.* (1930) DATA*

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A. INTRODUCTION

The paper by Smith *et al.* (9) is unique in the literature in providing evidence on age of walking in seven racial subgroups living in one place, and their data therefore remain of considerable value. They reported a lack of significant racial differences but a significant sex difference, and claimed, in comparing their results with three other studies, differences attributable to climate and social class.

Unfortunately, there were a number of weaknesses in the way they handled their results. First, while their evidence on six of the groups came from well-baby clinics, that on the Haole group (socially favored, English-speaking whites) came from written questionnaires completed by mothers when the children were of kindergarten age. Several studies have shown the errors of mothers' long-term recall over such time intervals (5, 6, 8). The tendency is to underestimate age of walking. While the data from the other six groups are doubtless subject to error, it is likely to be unsystematic, and they can be regarded as much more comparable than the data on the Haole group. Second, they based their estimation of racial differences on differences in medians, whereas an analysis of variance technique would have given a more satisfactory test. Third, in comparing sex differences, they added data from three other studies, widely separated geographically, and again compared medians. These data were also subject to the errors of long-term recall.

It was therefore considered worthwhile to rework the published data.

B. METHOD

As Smith *et al.* (9), themselves, demonstrate, age of onset of walking is not normally distributed. There is, therefore, a problem regarding the kind of transformation to use in order to make analysis of variance techniques appropriate. It has been shown elsewhere (4) that a logarithmic transformation

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[1] Grateful thanks are due to Mr. M. J. R. Healy for his helpful comments on the statistical analyses.

TABLE 1
MEANS AND *SD*s OF AGE OF WALKING, DATA OF SMITH *et al.* (9)
(Logarithm of age. Variances × 1000)

Measure	Chinese	Filipino	Hawaiian	Japanese	Korean	Portuguese	Haole
				Boys			
	($N = 44$)	($N = 28$)	($N = 34$)	($N = 157$)	($N = 14$)	($N = 46$)	($N = 51$)
Mean	1.1339	1.1086	1.1441	1.1316	1.1187	1.1365	1.0873
Variance (× 1000)	4.519	9.004	7.345	4.178	2.108	4.376	4.856
Median (months)	12.94	12.58	12.85	12.93	12.71	14.07	12.21
				Girls			
	($N = 42$)	($N = 27$)	($N = 34$)	($N = 140$)	($N = 23$)	($N = 32$)	($N = 49$)
Mean	1.1096	1.1134	1.1004	1.1181	1.0810	1.1099	1.0808
Variance (× 1000)	3.685	7.427	3.818	4.673	4.750	5.277	6.485
Median (months)	12.52	12.36	12.47	12.69	12.31	12.33	11.95

yields approximately, though not perfectly, normal distributions. It will be shown that such transformations worked reasonably well in the present case.

The data as published in Table 1 (9) have been used. Out of a total sample of 725, four late walkers for whom precise data are lacking, and who were excluded by Smith *et al.,* were excluded in the present study. The comparison of racial differences has been performed with, and without, the anomalous Haole group. It was not considered worthwhile to pay any attention to the data from the other three studies, with which the original authors had made comparisons.

C. Results

1. *Transformed Distributions*

The logarithmic transformation of the distributions could be adequately tested for normality only on the Japanese subgroup, as the others were much smaller. In the case of both the Japanese boys ($N = 157$) and girls ($N = 140$), the distribution of log-age of walking departed significantly from normality ($p < 0.001$), by χ^2 tests. However, a plot of the cumulative distributions on probit paper, which yields straight lines for normal ogives (2), showed little evidence of a systematic departure from normality (Figure 1); and in the light of a previous study (4) it was considered that the use of logarithmic transformations would not lead to great error, as analysis of variance techniques are not unduly sensitive to small departures from normality (10). The unlikelihood of further transformations being worthwhile was indicated by the lack of correlation between the means and variances (Table 1) of the 12 subgroups of boys and girls (rho = +.09).

2. *Racial Group Differences*

The variances of the subgroups (Table 1) differed significantly by a Bartlett test (10) in the case of the boys, both with the Haole group ($p < 0.02$), and without it ($p < 0.01$).[2] Among girls there were no such differences (in both analyses $p > 0.30$).

The means (Table 1) were compared by means of between-within analysis of variance. With the boys, account was taken of heterogeneous variance (10). When the Haole group was included, there were significant differences among both boys and girls (boys: $F^1 = 3.45$, *df* 6 and 86.3, $p < 0.01$; girls: $F = 2.19$, *df* 6 and 340, $p < 0.05$). When the Haole group was excluded, there were no significant differences among the means either among boys or among

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[2] These differences should be accepted with some caution, as the Bartlett test is sensitive to elongation of one tail of a distribution.

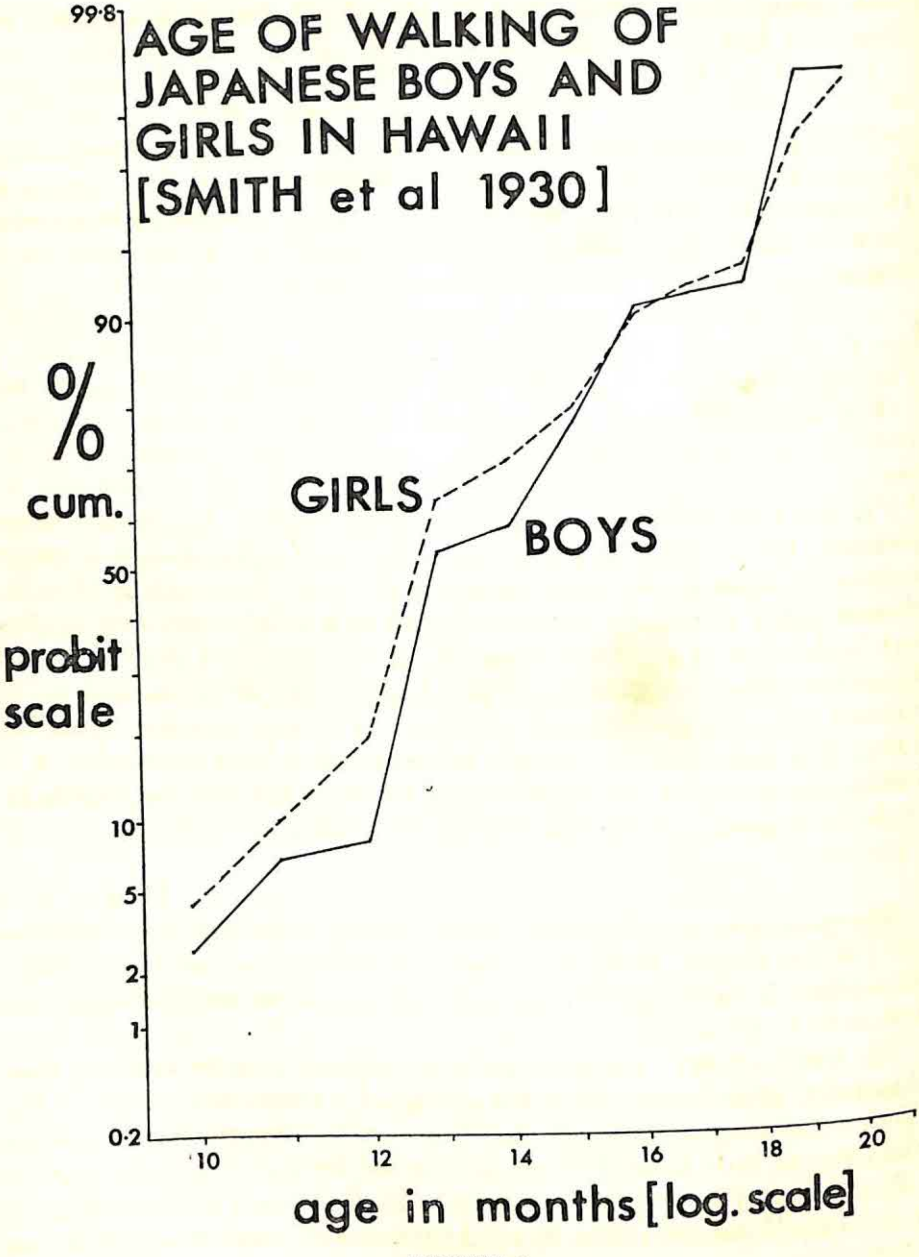

FIGURE 1
CUMULATIVE DISTRIBUTIONS OF LOGARITHM OF AGE OF WALKING OF JAPANESE BOYS AND GIRLS IN HAWAII; DATA OF SMITH *et al.* (9); PROBIT SCALE

girls (boys: $F^1 = 0.754$, df 5 and 73.4, $p > 0.50$; girls: $F = 1.34$, df 5 and 292, $p > 0.25$).

3. *Sex Differences*

Only the six comparable groups were used in looking for sex differences. In five groups girls walked earlier than boys, the sole exception being among the Filipinos (Table 1), where the difference was small. The lack of homogeneity of variance and nonorthogonality of the data rendered a two-way analysis of variance impractical. Estimates of the combined mean of boys, and of girls separately, were therefore made by weighting each subgroup mean according to its N and inversely according to its variance (7, pp. 49-51). The resulting weighted means (boys: 1.1302, girls 1.1104) differed highly significantly ($p < 0.001$).

D. DISCUSSION

The present results contradict those of Smith *et al.* (9) in one respect: namely, that inclusion of the Haole group, as they did, yielded significant differences between the racial groups (boys $p < 0.01$, girls $p < 0.05$), whereas they reported a lack of such differences. If one is prepared to ignore the lack of comparability of the data on the Haole group, one could conclude that this group, which is primarily responsible for the differences, walked earlier, either for genetic reasons or because of its more favorable social background. However, if the more prudent course is followed of excluding the Haole group, which course the original authors did not follow, their conclusions can be accepted: namely, that there is no evidence of significant racial differences in their data.

In the present study as in the original one, evidence was found of a significant sex difference. This finding is in contrast to the lack of any consistent or significant trends among five European samples (4). A possible explanation has been offered by the latter authors in terms of the hypothesis of Graffar *et al.* (3) that boys are more likely to be affected by adverse circumstances than girls, and that a difference would be more likely in the economic conditions of Hawaii in 1930 than in those of Western Europe in the 1950's.

One supplementary finding, which also applied to the five European samples, was that of heterogeneity of variance, in this case only among the boys, but in the European investigation among samples with boys and girls combined (4).

It appears, therefore, that as much interest may attach to differing variabilities in age of walking as in measures of central tendency. Unfortunately, Smith *et al.* did not provide any information about the subsamples which might suggest hypotheses as to why the Filipino and Hawaiian boys displayed much greater variability than the Korean or Japanese.

The suggestion of Smith *et al.* (9) that a warm climate may favor early walking, arising from a comparison with three U.S. studies based on mothers' long-term memories, received no support from the Dennises' study of Hopi babies (1), nor from that of Hindley *et al.* (4), in which Stockholm children walked sooner than those from more southerly European cities.

E. Summary

The data of Smith *et al.* provide unique information on age of walking of seven racial groups living in one place (Hawaii). As there were certain limitations in their analysis of their data, it was considered worthwhile to rework their data. Logarithmic transformations of age of first walking were used to enable analyses of variance to be done. When the racial groups were compared, there were no significant differences in means when the anomalous Haole group was excluded. When it was included, significant differences were found, in contrast to the claims of the original authors. Additionally, there were significant differences in variance among the different groups of boys ($p < 0.02$). There was a highly significant sex difference in means ($p < 0.001$). Reasons are discussed for the contradiction between the latter finding and that of Hindley *et al.* (4) on five European samples.

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THE GUTTMAN SCALE AS A MEANS OF TESTING PIAGET'S THEORY OF DEVELOPMENT*

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Various authors have stressed the applicability of Guttman's scalogram technique to the testing of Piaget's theory of development (1, 5, 9). Hunt explicitly stated that "If the order of the appearance of the structures is fixed, and if the presence of a later one always implies the presence of those which have appeared earlier, the result is a natural scale of intellectual development and intelligence with the properties Guttman [see (3, 4)] has described for ordinal scales" (5, p. 256). Similarly, Flavell claimed that ". . . one more type of study germane both to the test construction issue and to the validation of Piaget's work in general [is] the application of Guttman scalogram analysis to Piaget's stage sequences" (1, p. 364).

These suggestions are based upon the explication of Piaget's notions concerning stages of development. According to Piaget, stages have two distinct features: (*a*) They mark the steps along which development occurs, so that Stage B is more "mature" than Stage A. (*b*) Each stage is a necessary condition for the transition to the next stage.

In studies attempting to use the Guttman scale within the context of Piaget's formulations, two different methods of its application have been practised. One group of studies (7, 8, 9) used items of differential difficulty along various developmental dimensions, and tested the scalability of the items themselves. This type of analysis can test both features of the stage concept, since the actual comparison can be made between the success on a certain level of difficulty and performance on previous levels.

In another group of studies, specifically designed to test certain aspects of Piaget's theory, researchers have used the Guttman scale in a different manner (2, 6). They tested scalability on a single item by comparing different levels of responses on that item to some criterion of development, be it chronological or mental age. While such an approach can establish the order of development (i.e., the first feature of Piaget's concept of stage), *it does not deal with the second feature,* which is critical to Piaget's theory. In terms of this specific

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theory, it is not sufficient to show that responses categorized as more mature are systematically correlated with some other criterion of maturity. It is also necessary to show that any level of development presupposes the mastery of previous levels. Thus, the *S*s have to be tested on different levels at the same time.

As the Guttman scale is especially suited for the internal analysis of items testing different levels of difficulty, its applicability to validating Piaget's theory is self-evident. It is suggested, then, that the most appropriate approach would be an attempt *a priori* to select items representing different stages of development and to test for their scalability. External criteria, although important in establishing the progress of development, cannot replace the actual testing of the proposed structure underlying the progress.

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BEHAVIORAL DIFFERENCES BETWEEN RABBITS AND CATS*[1]

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A. INTRODUCTION

Ethologists attempt to incorporate the behavior of animals into general evolutionary theory. Learning, in this view, is only understandable in terms of ontogenetic modifications of general behavior patterns that have developed phylogenetically. The behavior patterns of any species are the results of a process of adjustment which is the result of an interaction between the genetic pool of the population of that species (i.e., phylogeny) and its "ecological niche." The ability to learn at all, and also what to learn, is important for some species, but not for others. Indeed, in many species adaptive behavior is independent of practice: certain well-defined aspects of the environment serve only as releasers. In the cases where environmental effects modify the behavior of an individual organism, these effects are mediated by inborn capacities and behavioral tendencies that helped the species to survive in the past. For this there is also evidence for *Homo sapiens* (14, 15, 19).

Ethologists investigated the behavior of animals mainly in their natural habitat. Laboratory animals are not suitable for this type of research. Laboratory animals are artificial products: they did not have to survive selective forces in nature, and they show signs of domestication (7). Many of the inborn behavior patterns that have survival value for the wild form of a species therefore degenerate. The new animals, however, thereby do not become *Tabulae rasae,* but the genetically determined mediations of environmental impacts may become even less predictable in comparison with the wild form, because the particular domestication effects are usually unknown to psychologists using these animals. It is, therefore, not surprising at all that different

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[1] This paper is based on a dissertation submitted to the graduate school of the University of Arkansas in partial fulfillment of the requirements for the Ph.D. degree. The author wishes to thank Hardy C. Wilcoxon, who supervised this investigation and who interestedly helped with every phase of the experiments, and Marian and Keller Breland, whose general ideas have been utilized here.

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strains of rats behave differently in the same situation (12), not to mention different species (2, 3, 13). The purpose of the present report is to present additional evidence for the above remarks.

B. HYPOTHESIS

Cats, being carnivorous animals, are more easily motivated by food deprivation than are rabbits, which are herbivores. Furthermore, cats are much more food oriented (they stalk their prey) than are rabbits. This may be a genetically determined behavior pattern which would not be in accord with species-independent predictions derived from learning theory; particularly Hull's goal-gradient hypothesis (8) would suggest that both species reduce delay of reinforcement if given the chance. Hull developed the goal-gradient hypothesis on the basis of data from rats in a runway. Running time has been shown to be a function of food deprivation for rats, several times (4, 10). Other species have not been tested in this regard. Therefore, the cats and rabbits were exposed to a runway.

C. METHOD

1. *Apparatus*

The runway was 16 feet long and one foot high. Floor and walls were covered with galvanized tin. The width was four inches, so that the animals could not turn around while running. The two endboxes were 2 × 1 × 1 feet in dimension. Alley and endboxes were covered with wire mesh and translucent wax paper, so that the animals could see their way, but could not look out. There was a bar at the rear wall of one endbox. Above the bar was a two-inch hole through which a 25-watt light bulb shone for one second when *S* pressed the bar successfully; and food was automatically delivered at the other endbox.

2. *Subjects*

Subjects for all subsequently reported experiments were taken from 15 alley cats which were obtained after weaning. They were between 2 and 6 months old by the time they came into the laboratory. Most of them were from different litters. Males and females were mixed and there were no pure-bred animals among the cats. The rabbits were all male, belted Dutch from Pat Bass Rabbitry, Monnet, Missouri. They all were 3 months old when they came into the laboratory, and about 6 months when the experiments started. Dutch belted rabbits are bred for exhibition purposes and are judged on the basis of their black and white fur design. They can be motivated by hunger, which is not true for all kinds of rabbits.[3]

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[3] Keller Breland found that other strains of rabbits, particularly the New Zealand,

The behavior of cats and rabbits was compared (*a*) in a double runway, (*b*) in a simple runway, and (*c*) in a Skinner box. Only with the double-runway method were significant differences obtained. Experiments 1 and 2, which follow below, use the double-runway technique, but different experimental designs. Since the negative results of the Skinner box and simple runway methods are quite meaningful in the present context, they are briefly presented in the section entitled "other experiments" below.

D. Experiment 1

Experiment 1 was performed with three cats and three rabbits. It is presented in three parts: (*a*) training sessions, (*b*) test sessions, and (*c*) a series of increasing hunger sessions.

1. *Training Sessions*

a. Procedure. The animals first learned to associate a one-second flash of a 25-watt light bulb with the presence of food in a dish of one endbox. Initially the bar was close to the food dish, and was gradually moved to the back wall of the other endbox, 20 feet away. After all six *S*s had learned to run to the barbox, press the bar, receive a light flash, and to run back to their self-delivered food pellets, they all underwent daily training sessions of varying lengths, acccording to their individual performance, for 15 consecutive days. The animals received between 20 and 60 grams of food per day, again, depending on their individual performance: i.e., less if they performed poorly.

b. Measures. The following data were electrically recorded: time in seconds from leaving the foodbox until the bar was pressed (F — B), and time in seconds from the moment the bar was pressed until *S* reentered the foodbox (B — F).

c. Results. The results of the training sessions are summarized in Table 1. All three cats ran much more slowly to the barbox than to the foodbox. Two of the three rabbits did the reverse, and one rabbit ran back and forth at about the same speed.

2. *Test Sessions*

a. Procedure. During the training sessions it was found to be necessary that the animals did not notice *E*. The cats formed an attachment to *E* very easily, and their food-directed activities were disturbed by any kind of stimulation coming from outside the runway. The only trials measured were those

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could hardly be motivated by food deprivation at all (Keller Breland, personal communication).

TABLE 1
SUMMARY OF EXPOSURE AND PERFORMANCE OF THREE CATS AND THREE RABBITS IN A 16-FOOT RUNWAY DURING A 15-DAY TRAINING PERIOD

Animal	Total time in hours	Total No. of trials	Means/sec. (F — B)	Means/sec. (B — F)	Ratio
Cat 1	6:25	364	12.57	5.39	0.43*
Cat 2	7:55	448	14.67	6.35	0.43*
Cat 3	8:10	172	10.79	4.10	0.38*
Rabbit 1	9:00	199	7.34	6.93	1.06
Rabbit 2	9:25	156	6.89	8.45	1.22*
Rabbit 3	10:05	144	9.48	16.54	1.74*

* $p < 0.005$ (t test).

in which *S*s completed each run in either direction within 60 seconds and in which the bar was pressed successfully. Such trials are hereinafter called "valid trials." Only one reinforcement was available per run, no matter how often the bar was pressed. The introduction of the valid trial criterion with the 60-second limit became necessary for a number of reasons: during the trials that lasted longer, the rabbits often shook the bar with their teeth and often emptied the whole magazine before running back to the foodbox. Cats, as well as rabbits, sometimes stopped somewhere in the middle of the runway and did not continue running for several minutes.[4] The cats occasionally stuck their paws through the holes for the photoelectric cells which operated the clocks; sometimes they also pressed the bar repeatedly, not as the rabbits shattering it with the teeth, but only twice or three times with the paws.

Ten days after the last training session (section D-1 above), the same three cats and three rabbits were given five test sessions on five consecutive days, at the same time each day. Each cat was exposed to the runway for 20 minutes daily, and each rabbit for 30 minutes. These exposure times were chosen because a number of irregularities appeared after that period, and increased rapidly then. The measures taken were the same as in Experiment 1 (section D-1). The total amount of food daily was 60 grams for the cats and 50 grams for the rabbits, including the amount needed for reinforcements.

b. Results. The results of the test sessions are summarized in Table 2. All three cats ran to the fodbox in about half the time they needed to get to the barbox (ratios for Cat 1: 0.58; Cat 2: 0.44; Cat 3: 0.47). The rabbits travelled in both directions either at the same speed (ratio for Rabbit 1: 1.06) or they ran faster to the barbox than to the foodbox (ratios for Rabbit 2: 1.52; Rabbit 3: 1.71).

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[4] As the experiments progressed, the animals eventually stopped doing this.

TABLE 2
SUMMARY OF PERFORMANCE OF THREE CATS AND THREE RABBITS IN A 16-FOOT RUNWAY DURING A FIVE-DAY TEST PERIOD

Animal	Total No. of valid trials	Means/sec. (F — B)	Means/sec. (B — F)	Ratio
Cat 1	192	8.56	4.97	0.58*
Cat 2	154	12.76	5.66	0.44*
Cat 3	160	8.75	4.14	0.47*
Rabbit 1	119	6.27	6.45	1.06
Rabbit 2	98	6.88	10.46	1.52*
Rabbit 3	105	7.79	13.34	1.71*

* $p < 0.005$ (t test).

3. *Increasing Hunger Sessions*

The comparison of Table 1 and Table 2 shows that the (F — B) times decreased for the three cats relatively more during the test sessions than did the (B — F) times. If this trend were to continue, the discrepancy between the (F — B) and the (B — F) times would eventually cease to exist. The performance of Rabbit 2 suggested a lengthening of the (B — F) times as compared with the (F — B) times. If this turned out to be a general trend for the rabbits, then they might eventually spend all their time in the barbox. Prolonged exposure to the runway, and increasing hunger were thought to be the two factors most likely to intensify this trend.

a. Procedure. Ninety days after the test sessions (section D-2 above), during which the animals had free access to food in order to regain their normal weight, *S*s were retrained until they had reached their previous performance levels. From that day on they ran 16 trial sessions each, again 20 minutes long for the cats, and 30 minutes for the rabbits. The schedule was as follows: Session 2: three hours after feeding; Session 3: six hours after feeding. From Session 3 on *S*s ran after additional six, 12, 12, 18, 18 hours, plus nine more sessions that were 36 hours apart each, without any additional food between sessions: *S*s received all their food in the runway for a period of 396 hours: i.e., 16-1/2 days.

b. Results. Table 3 summarizes the results. With increasing hunger the number of trials per session increased, and the running times became more constant, although more so for the cats than for the rabbits. Nothing changed with respect to the time relationships between (F — B) and (B — F), except for Rabbit 2, which had to be replaced by another animal from another experiment. Substitute Rabbit 2 had not regained its original weight yet. The results of the training sessions and test sessions of Experiment 1 were confirmed under most severe starvation conditions. During the three parts of Experiment 1 all three cats had run more than 1000 trials each, while Rabbit 1 had run 784; and Rabbit 3, 590 trials.

TABLE 3

SUMMARY OF PERFORMANCE OF THREE CATS AND THREE RABBITS ON ONE TEST AND 16 INCREASING HUNGER SESSIONS IN A 16-FOOT RUNWAY

Animal	Total No. of trials	Total No. of valid trials	Means F — B	Means B — F	Weight lost %	Ratio
Cat 1	720	702	8.04	4.54	18.2	0.56
Cat 2	463	457	13.75	7.28	16.7	0.53
Cat 3	956	939	7.38	3.54	28.5	0.48
Rabbit 1	551	466	5.32	5.74	21.3	1.08
Rabbit 2*	416	328	8.91	6.80	33.3	0.76
Rabbit 3	424	341	8.26	13.39	30.0	1.62

* See text; p for all *S*s < 0.01 (t test).

E. EXPERIMENT 2

In the three parts of Experiment 1 each animal determined its own number of trials within a given period of time. Practice remained an uncontrolled variable. In Experiment 2, therefore, the number of trials was held constant for all *S*s, and also during the testing period. A larger number of *S*s than in Experiment 1 was employed to make a statistical analysis of the data possible. Finally, more rigorously controlled levels of deprivation were used than in Experiment 1.

1. *Method*

a. Apparatus. The alley from Experiment 1 was used with the following changes: the sheet metal was removed and the width increased to 10 inches, because the animals had almost never tried to turn around before reaching the bar. Some observed hesitations of the rabbits before they returned to the foodbox after pressing the bar may have been due to the relative weakness of the secondary cues. One light bulb was therefore suspended from the entrance to the barbox; it turned on the moment the animal pressed the bar successfully, and it stayed on until *S* entered the foodbox. An additional light bulb was mounted directly above the bar. The entire runway was again covered with wire mesh and translucent wax paper.

b. Subjects. Six naive cats, all under 1 year of age, and six naive belted Dutch rabbits, also under 1 year of age were used.

c. Procedure. In order to train the animals, a "sliding bar" was constructed. Together with the light bulb that flashed for one second, it was mounted on a panel that was slowly moved through the runway during training, starting from the foodbox. The second light bulb was always suspended from the wire mesh two feet behind the panel during training. Within 10 days all six cats were trained, and within 15 days all six rabbits: i.e., the bar panel had reached the rear wall of the barbox. Each *S*, after having mastered the problem, received 70 additional trials on four consecutive days.

d. Design. After training *S*s were exposed to the runway after 24, 48, 72, 72, 48, and 24 hours of food deprivation. Each *S* had to complete 20 valid trials per session. Each session was followed by three days of free access to food, except the second 72-hour session, which was preceded by six days of free access to food.

e. Measures. The two sets of measures were as follows: (*a*) time *S*s took from leaving the foodbox until pressing the bar (F — B), and time from pressing the bar until reentering the foodbox (B — F); and (*b*) time from leaving the foodbox until entering the barbox, and from leaving the barbox until reentering the foodbox. The first set of measures is identical with those of Experiment 1. The second set of measures was designed to show whether the fact that two of the three rabbits in Experiment 1 took longer to get to the food than to the bar was due to latency in the barbox after pressing the bar or to actual differences in running time.

2. *Results*

Figure 1 presents the results in form of ratios between the times the animals needed to run to the food and to the bar. The broken lines, labeled $4/2 = (B - F)/(F - B)$ are the ratios of the first set of measures. The solid lines of Figure 1, labeled $3/1 =$ time toward food/time away from food are the ratios of the second set of measures. The *t* test for the ratios between species for both sets of measures yielded significance levels well below the 1 per cent confidence limit. Analyses of variance for each species separately did not reveal any effects of hours of deprivation on the rabbits at all. The cats, however, ran more slowly to the bar under the 24-hour deprivation condition ($p < .01$) for the foodbox-barbox measures, and $p < .01$ for the (F — B) measures. There were large individual differences within both species. The cats *gained* 11 per cent, and the rabbits *gained* an average of 11.12 per cent in body weight during the experimental period. Figure 1 also reveals that part of the fact that in Experiment 1 the rabbits needed longer to go to the foodbox after pressing the bar was due to latency in the barbox. The ratio of the $(F - B)/(B - F)$ set of measures was 1.31, as compared to 1.10 for the pure running times. The comparable average ratios for the cats were 0.44 and 0.43. In Experiment 2 the results of Experiment 1 were repeated with a statistically controlled design.

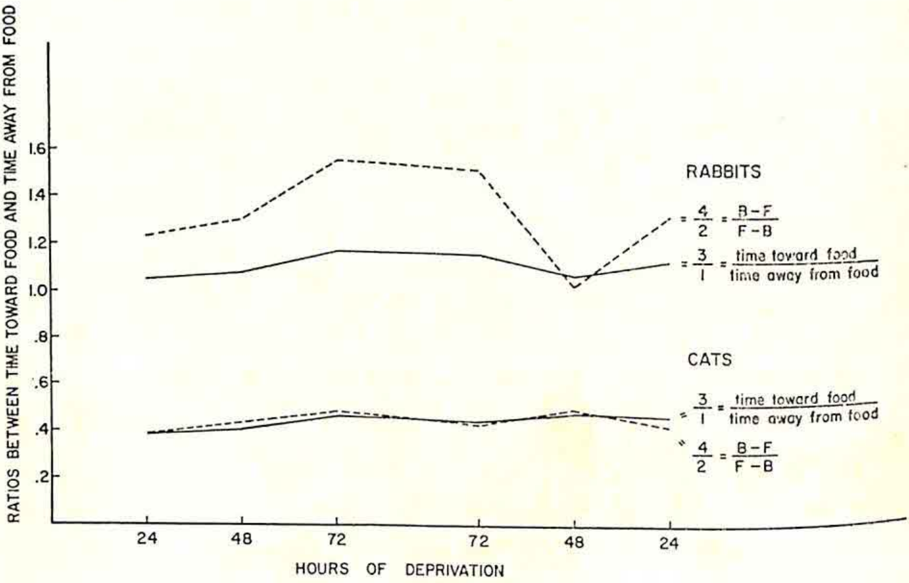

FIGURE 1
RATIOS BETWEEN RUNNING TIME TOWARD FOOD AND AWAY FROM FOOD FOR CATS AND FOR RABBITS. THE SOLID LINES ARE THE RATIOS FOR THE MERE RUNNING TIME (TOWARD FOOD/AWAY FROM FOOD). THE BROKEN LINES ARE THE RATIOS OF (B — F)/(F — B); SEE TEXT FOR EXPLANATION

F. OTHER EXPERIMENTS

In a number of additional experiments *E* attempted to demonstrate comparable behavioral differences between cats and rabbits in the Skinner box. On the basis of the original hypothesis that cats are more easily aroused by hunger than are rabbits, it could be possible that, as compared with cats, it takes rabbits *longer* to press the bar at a higher rate if they are more severely food deprived. Variable interval schedules of reinforcement of 150 seconds were used.

For three cats and three rabbits the cumulative records and the number of bar presses per minute did not reflect any lawful relationships between hours of deprivation and bar pressing behavior. The cumulative records conformed well with the familiar straight lines of variable interval schedules of reinforcement (6). However, the variations in response rate—i.e., slope of the curves—which did occur from day to day for each of the six *S*s during the

60 days in which the baselines were established (16), were as large as the rather inconclusive variations that occurred during the test sessions when the deprivation times were manipulated. A significant loss in body weight between 15 and 30 per cent had to occur before the animals worked at all consistently. Only under the shortest interval—six hours of food deprivation—all six *S*s slowed down slightly in their response rate. There were also no detectable differences in response output between the two species during extinction. The variations between the species were as large as within the species.

In order to obtain a possible explanation for these findings, a simple runway experiment was conducted. Three different cats and three rabbits were exposed to the runway as used in Experiment 2 above; they ran only from the start box to the goal box and were under the same deprivation conditions as the animals in the Skinner box experiment described above. *S*s were carried back to the start box after each trial by *E*. Under all deprivation conditions the animals performed in the same manner, without significant deviations on the following measures: latency in the start box, running time to the goal box, and time needed for the consumption of two grams of dry food per trial.

G. Discussion

The experiments in which cats and rabbits ran back and forth in a 16-foot runway show that there are basic behavioral differences between the two species with regard to their food orientation. Conditioning techniques, under a variety of deprivation states, including severe starvation, could not cause the cats to leave the foodbox faster in order to press the bar for new food. The cats could have increased their food consumption about 1.45 times under the increasing hunger conditions of Experiment 1 (section D-3 above) if they had run as fast to the bar as they did to the food.

Cats were affected by different levels of food deprivation, but only when they ran from the foodbox to the barbox. Neither cats nor rabbits showed any change in speed for various levels of food deprivation in the barbox—foodbox direction. This is a very surprising result in the light of King's study [in Kimble (9, p. 407)], whose *rats* did run faster to the reward when deprivation was higher.

The results, which were obtained from the simple runway experiment, in which cats and rabbits ran from a start box to a goal box, point to the same direction. In this case, however, the animals were extremely hungry, because they were under the same deprivation conditions as the animals in the Skinner box. Their latencies never decreased, and their running times and "vigor" of consumption never increased during the experiment.

Two possibilities could account for the failure to demonstrate behavioral differences between cats and rabbits in the Skinner box: (*a*) Because of the extreme deprivation that must take place before the animals produce "good" cumulative records, the finally tested deprivation levels remained without any effect. This interpretation is suggested by the comparison with those animals that in the simple runway, failed to show any behavior indicating a relation between independent and dependent variables. The animals may have worked at their upper limits under the prevailing conditions. *S*s working in Skinner boxes under "thin" schedules of reinforcement have to be deprived far beyond the deprivation level under which animals learn in many other situations. On the other hand, as already mentioned, in none of the runway experiments did *S*s run faster to the food as a function of increased deprivation. (*b*) The Skinner box is an apparatus that seems to force uniformity upon organisms which in only a few other situations would behave uniformly (2). The Skinnerian approach (17) appears to be disinterested in biologically meaningful species differences. There are lawful relationships that have been discovered by means of the Skinner box, but the extent to which such findings can be generalized to other species must still be carefully investigated. Skinner, for example, presents "identical curves" for bar pressing behavior of a pigeon, a rat, and a monkey. He says: "Which is which? It does not matter. Of course, these three species have behavioral repertoires that are as different as their anatomies. But once you have allowed for differences in the ways in which they act upon the environment, what remains of their behavior shows astonishingly similar properties. Mice, cats, dogs, and human children could have added other curves to this figure" (18, pp. 374-375).

The writer feels that this position *artificially* excludes species differences. It may imply saying that if one has been successful in constructing an apparatus that imposes uniformity on the behavior of different species, then different species behave alike. Only a slight extrapolation of this way of thinking, the author feels, could lead to the statement that behavior is a function of the apparatus, and not primarily of the organism.

The different behavior of the cats and rabbits does not support the conviction that general laws of behavior can be found by disregarding evolution.[5]

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[5] Bitterman (1) accuses Darwin of having initiated the insensitivity of modern comparative psychology to species differences. Darwin, however, was quite aware of the relation between behavioral differences and the ecological niches of a species (5). It is more than likely that J. B. Watson's prescientific environmentalism still dominates the scene. Bitterman's historical analysis is the more surprising due to the fact that he otherwise seems to be in agreement with the general evaluation presented here.

Breland and Breland (2) would probably call the self-imposed delay of reinforcement by the cats "instinctive drift." Perhaps Konrad Lorenz has something similar in mind when he says: "The false belief that one is able to, or even forced to use operational concepts only—i.e., concepts that are exclusively determined by the possibilities of experimental tests—leads necessarily to the exclusion of structures that have developed phylogenetically, and that are determined by the selective pressure of their function. In the last analysis this leads to the exclusion of the whole organism" (11, p. 151).

H. SUMMARY

Domesticated cats and belted Dutch rabbits learned to traverse twice a 16-foot runway with 2 two-foot endboxes. They learned to press a bar at the rear wall of one endbox, receiving food at the rear wall of the other endbox. Cats took more than twice as long to get to the bar as to the food. The rabbits ran about equally fast in either direction. Running time toward food alone did not change with various deprivation states for either species.

In the Skinner box (under variable interval schedules of reinforcement of 150 seconds) neither did species differences occur, nor any lawful changes of behavior as a function of food deprivation. Similarly, in a simple runway, where cats and rabbits merely learned to run from a start box to a goal box, no changes in behavior occurred as a function of food deprivation for three dependent measures.

It was concluded that the Skinner box imposes an artificial uniformity on otherwise different organisms, that behavioral generalizations that neglect species differences are of limited value, and that the kind and the circumstances of learning—even with domesticated animals—depend on the species and the particular ecological niche to which it adapted during phylogenesis.

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LINGUISTIC FUNCTIONS OF BILINGUAL MEXICAN-AMERICAN CHILDREN*

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A. Introduction

Opinion differs as to the linguistic functioning of children of foreign-language homes who learn two languages simultaneously as they grow up. It appears that of the limited amount of research in this field the results have been somewhat equivocal.

Several early studies (4, 6, 7) have suggested that bilinguals are retarded in certain areas of language development. These investigators did not control intelligence and socioeconomic status. More recently, Lewis (5) found the English attainment of 10-year-old Welsh school children to be influenced adversely by Welsh language background. Nonverbal intelligence was controlled in this study.

Carrow (3), who attempted to control socioeconomic status, as well as nonverbal intelligence, found bilingual Mexican-American third-grade children to be inferior to monolingual children in oral reading accuracy, oral reading comprehension, hearing vocabulary, arithmetic reasoning, and speaking vocabulary. She theorized that, while she had found no significant differences between bilinguals and monolinguals in silent reading vocabulary, such results might be found between such groups at a higher grade level.

Brown (2, p. 308) found a significant relationship between school achievement and language spoken in the home for Mexican-American fourth-grade children, but not for sixth- and eighth-grade children.

Studies of the linguistic functioning of bilingual and monolingual college students (1, 9) have suggested that any adverse effects of bilingualism on language development during early childhood may no longer exist by late adolescence. This suggests that differences in language development between monolingual and bilingual children diminish as they mature and progress in school.

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The foregoing would seem, then, to justify a study comparing the linguistic function of bilingual and monolingual children at an age level above that of the subjects of Carrow's study (3) and Lewis' study (5). For this reason, seventh- and eighth-grade subjects were selected for the present investigation. The study was concerned with the linguistic functioning of children of a Spanish and English language-cultural environment. The specific problem was to study the effect of this environment on linguistic functioning by means of comparison, in certain areas of language development, of three groups of children who differed in certain identifiable aspects of language-cultural background but who were alike in nonlanguage intelligence, chronological age, grade, sex, and socioeconomic status. The three groups were (*a*) Mexican-American children who had spoken both English and Spanish, (*b*) Anglo-American children who had spoken only English, and (*c*) Mexican-American children who had spoken only English.

B. PROCEDURE

1. *Sample*

Sources of subjects were five elementary schools housing seventh- and eighth-grade pupils in three school districts in southern California. Three groups of 30 subjects each were selected. One group, called the English-Spanish (E-S) group, was composed of children who had spoken both English and Spanish at the time they entered kindergarten. A second group, called the Anglo-English (A-E) group, was composed of Anglo-American children who had spoken only English before entering kindergarten. A third group was composed of Mexican-American children who had spoken only English before entering kindergarten. This group was called the Mexican-English (M-E) group. The M-E group was composed of children whose parents or grandparents had come from Mexico. The parents of children in the M-E group spoke both English and Spanish.

In each group there were 10 seventh-grade children and 20 eighth-grade children. There were 14 boys and 16 girls in each group. Nonlanguage *IQ*s were obtained for each child from California Mental Maturity Test data. The decision to match groups according to *nonlanguage IQ*, rather than according to total or language *IQ*, was based on the assumption that obtained nonlanguage *IQ*s would be influenced less by possible language factors under consideration. Each subject was classified as to socioeconomic status according to the scale developed by Warner, *et al.* (11, pp. 140-141).

All subjects had previously been screened by means of pure-tone sweep-check tests and appeared to have normal hearing. None appeared to have an organic speech defect, and none had been referred to a school guidance department as possibly "neurologically injured" or "emotionally disturbed." No subject had an obtained *IQ* of lower than 75.

Mean nonlanguage *IQ* was 100.27 for the E-S group, 103.43 for the A-E group, and 104.03 for the M-E group. Analysis of variance yielded an *F* score of .76. Mean chronological age, in months, was 156.53 for the E-S group, 155.7 for the A-E group, and 155.97 for the M-E group. The *F* score was .06. Mean socioeconomic rating was 4.23 for the E-S group, 3.97 for the A-E group, and 3.73 for the M-E group. The *F* score was 1.46. In each case, the *F* score indicated that differences were not significant among groups at the .05 level.

2. *Instruments*

The following measures were used to obtain data regarding the linguistic functioning of the subjects:

1. The California Test of Achievement, junior high level (10), was used to measure achievement in silent reading (vocabulary and comprehension), mechanics of English, spelling, and general language development.

2. The Gray Oral Reading Test (1963) was used to measure oral reading accuracy and comprehension.

3. The Wepman Auditory Discrimination Test (12) was used to measure phonemic discrimination.

4. A phonetic inventory was used to evaluate consonant articulation. Each subject identified the pictures on the 16 Test Cards, Set A, published by Scott, Foresman, and Company (8). Consonant substitutions, distortions, additions, and omissions were transcribed by the present investigator. Each error was counted only once, regardless of the number of times it occurred in the subject's speech.

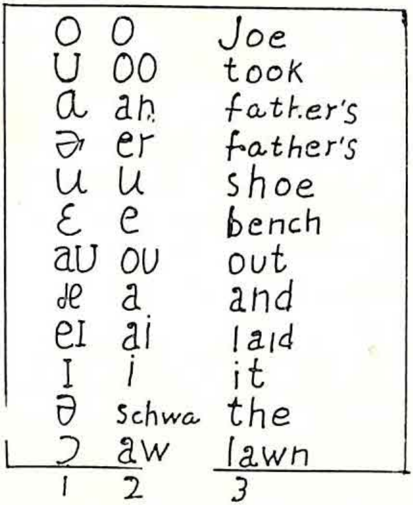
5. A three-minute tape-recorded speech sample for each subject was rated by three credentialed school-district speech therapists on a five-point scale as to inflection.

To obtain the speech sample, each subject was shown a picture and asked to relate the story that the picture suggested to him. The samples were recorded and later played back in random order for evaluation by the three speech therapists. The scores by the three therapists were totaled for each subject and the sums recorded.

6. Sound spectrograms were made, from which were obtained acoustic measures of vowel productions of each subject. Vowel productions were obtained in the following manner. Each subject spoke the sentence "Joe took father's shoe bench out and laid it on the lawn." After the subject had practiced the sentence several times, the sample was tape-recorded. Broad-band spectrograms were made from the tapes.

Because of noisy conditions and other difficulties in obtaining the speech samples, it was impossible to get reliable and readable spectrograms for all subjects. From the subjects for whom spectrographic measurements could be made, it was possible to match 18 subjects in each of the three groups according to grade and sex. Thus for purposes of the spectrographic study, there were in each group seven boys and 11 girls. Six subjects in each group were in the seventh grade and 12 were in the eighth grade. Mean nonlanguage *IQ* was 101.89 for the E-S group, 103.83 for the A-E group, and 105.67 for the M-E group. Analysis of variance yielded an *F* score of .36. Mean chronological age in months was 155.39 for the E-S group. The *F* score was .63. The mean socioeconomic status rating was 4.17 for the E-S group, 4.0 for the A-E group, and 3.78 for the M-E group. The *F* score was .49. None of the *F* scores was significant at the .05 level.

Acoustic measures were made for 10 vowels and two diphthongs. Figure 1



1	2	3
o	o	Joe
ʊ	oo	took
ɑ	ah	father's
ɚ	er	father's
u	u	shoe
ɛ	e	bench
aʊ	ou	out
æ	a	and
eɪ	ai	laid
ɪ	i	it
ə	schwa	the
ɔ	aw	lawn

FIGURE 1
INTERNATIONAL PHONETIC ALPHABET SYMBOL FOR EACH VOWEL AND DIPHTHONG (COLUMN 1), THE CORRESPONDING NAME BY WHICH EACH IS REFERRED IN THE TEXT AND TABLES (COLUMN 2), AND THE WORD IN WHICH EACH OCCURRED (COLUMN 3)

gives the International Phonetic Alphabet symbol for each vowel and diphthong, the corresponding name by which each is referred in the text and tables, and the word in which each occurred. The following measures were made.

Frequencies of the first and second formants were measured at a point one-fourth the duration of the whole vowel. For each of the two diphthongs, the frequencies of the two formants were measured at the inception and at the termination. For each vowel or diphthong, the frequency of the first formant (F_1) was subtracted from the frequency of the second formant (F_2) and the remainder was recorded.

Duration was measured from the spectrograms. Vowel duration was defined as two clear-cut formants in the appropriate frequency regions.

Fundamental frequency was measured by averaging the number of vertical striations of the spectrogram over a .05-second interval in the mid-portion of the vowel.

3. *Statistical Treatment*

Except for consonant articulation, a three-way analysis of covariance, with nonlanguage *IQ* as the covariate, was made for each of the dependent variables. Differences were accepted if significant at the .05 level of confidence. Analyses of covariance were followed by appropriate multiple-range tests.[2]

The distribution of errors in consonant articulation did not approximate a normal curve. Wilcoxon Matched Pairs Signed Ranks Tests were computed to test differences among groups in the total number of consonant articulation errors.

C. RESULTS

Table 1 presents the mean scores and standard deviations of the three groups on measures of linguistic function. Also presented are the *F* scores based on the analyses of covariance. There were no significant differences among the groups in silent reading vocabulary, total silent reading, spelling, or phonemic discrimination. There were significant differences among the groups in silent reading comprehension, oral reading accuracy and comprehension, inflection, and general language development. Multiple-range tests revealed that all significant differences were between the A-E group and the E-S group. There were no significant differences between the A-E and M-E groups.

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[2] The multiple-range test is applied by means of comparison of the difference between means with the shortest significant range corresponding to the value found, according to the number of subjects and degrees of freedom, in Duncan's table of significant studentized ranges. See Duncan, D. B., Multiple-range and multiple *F* tests, *Biometrics,* 1955, **11**, 1-42.

TABLE 1
MEAN SCORES AND STANDARD DEVIATIONS OF THE THREE GROUPS ON MEASURES OF LINGUISTIC FUNCTIONING WITH *F* SCORES DERIVED FROM THREE-WAY ANALYSES OF COVARIANCE WITH NONLANGUAGE *IQ* AS THE COVARIATE

Measure	E-S		A-E		M-E		*F*
	Mean	*SD*	Mean	*SD*	Mean	*SD*	
Silent reading							
Vocabulary	71.9	17.58	80.27	17.39	80.4	17.21	1.66
Comprehension	69.8	15.83	81.7	20.97	79.5	12.08	3.55*
Total	141.77	31.94	161.97	35.78	159.9	26.56	2.92
Mechanics of English	73.07	20.78	86.57	20.67	84.7	18.05	3.29*
Spelling	66.57	19.79	76.3	15.01	75.63	16.29	2.25
Oral reading							
Accuracy	48.6	20.32	60.13	15.79	60.1	13.52	3.93*
Comprehension	23.87	9.2	29.8	8.23	28.2	6.98	3.56*
Phonemic discrimination	4.53	1.52	4.47	2.16	3.97	1.32	
Inflection	10.73	1.39	9.9	1.45	9.67	1.49	4.28*
General language development	279.53	68.02	325.27	63.07	317.17	55.88	3.81*

* Significant at the .05 level of confidence.

Subjects in the E-S group made a total of 23 consonant-articulation errors. This included 14 substitutions and nine distortions. One distortion was recorded for the A-E group. One substitution and two distortions were made by M-E subjects. When the E-S group was compared with the A-E group, the Wilcoxon Matched Pairs Signed Ranks Test yielded an *N* of 10 and a *t* of zero. When the E-S group was compared with the M-E group, the *N* was 13 and the *t* was 9. These results were significant at less than .01. When the M-E and A-E groups were compared, the *N* was 4 and the *t* was 5. The results were not significant.

In formant location, significant differences were found for only three vowels: /o/, /e/, and /i/ (Table 2). Multiple-range test results revealed that for the /o/ and /e/ vowels there were significant differences between the E-S group and each of the other two groups. In formant location of the /i/ vowel, there was a significant difference between the M-E group and the other two groups. The difference between the E-S and A-E groups was not significant.

There were significant differences among groups in mean duration of the /ai/ diphthong and the /aw/ vowel (Table 3). For the /ai/ diphthong, the multiple-range test showed a significant difference between the E-S and M-E groups. The difference between the E-S and A-E groups and the A-E and

TABLE 2
SUMMARY OF MEAN FORMANT POSITION MEASUREMENTS AND STANDARD DEVIATION OF THE THREE GROUPS OF 18 SUBJECTS EACH AND *F* SCORES DERIVED FROM THREE-WAY ANALYSES OF COVARIANCE WITH NONLANGUAGE *IQ* AS THE COVARIATE. FORMANT POSITION WAS DETERMINED BY SUBTRACTING THE FREQUENCY OF THE FIRST FORMANT FROM THAT OF THE SECOND FORMANT

Vowel	E-S		A-E		M-E		
	Mean	*SD*	Mean	*SD*	Mean	*SD*	*F*
o	531.67	143.41	455.28	68.44	416.94	113.09	4.99*
oo	737.2	200.35	726.67	150.1	662.78	194.39	0.817
ah	486.0	118.48	502.22	116.94	481.94	80.31	0.177
er	799.44	193.65	924.44	217.18	831.94	227.67	1.71
u	669.44	204.59	605.56	157.03	560.28	56.53	2.31
e	996.39	135.17	1150.83	220.62	1219.44	139.05	7.67**
ou$_1$	636.67	207.02	628.89	154.79	604.17	149.18	0.32
ou$_2$	583.61	186.01	622.78	191.86	577.22	148.28	0.35
a	770.0	247.15	932.5	293.22	940.0	186.42	2.82
ai$_1$	615.83	185.06	653.06	243.63	643.06	157.32	0.12
ai$_2$	768.89	269.47	888.33	279.18	996.39	277.22	2.79
i	980.83	253.9	1061.67	305.46	1287.5	270.35	5.82**
Schwa	824.44	159.12	826.67	315.3	735.28	131.24	0.86
aw	506.67	117.57	513.61	138.77	499.17	56.16	0.17

* Significant at the .05 level of confidence.
** Significant at the .01 level of confidence.

M-E groups did not reach significance. In mean duration of the /aw/ vowel, the multiple-range test showed a significant difference between the M-E group and the other two groups. There was no significant difference between the A-E and E-S groups.

TABLE 3
SUMMARY OF MEAN DURATION MEASUREMENTS AND STANDARD DEVIATIONS OF THE THREE GROUPS OF 18 SUBJECTS EACH AND *F* SCORES DERIVED FROM THREE-WAY ANALYSES OF COVARIANCE WITH NONLANGUAGE *IQ* AS THE COVARIATE

Vowel	E-S		A-E		M-E		
	Mean	*SD*	Mean	*SD*	Mean	*SD*	*F*
o	160.56	44.26	178.33	21.76	162.78	47.16	1.06
oo	106.94	37.22	108.33	35.36	103.33	39.89	0.085
ah	148.89	33.06	164.44	22.55	161.11	23.98	1.87
er	121.67	27.06	131.67	15.81	136.67	25.2	2.27
u	142.22	52.64	163.89	45.0	138.33	36.01	1.7
e	133.61	31.24	153.78	20.54	139.72	27.0	2.37
ou	174.44	31.1	192.5	40.88	200.28	35.08	2.74
a	110.56	39.18	120.0	20.7	125.83	34.99	0.75
ai	159.17	39.04	180.56	41.23	198.89	38.02	4.37*
i	97.22	32.68	113.89	30.51	110.0	22.75	1.79
Schwa	101.11	37.56	105.56	19.16	120.56	28.79	2.14
aw	124.44	29.15	141.11	20.55	160.28	27.68	8.57**

* Significant at the .05 level of confidence.
** Significant at the .01 level of confidence.

In mean fundamental frequency, there were significant differences among the groups for the /e/ and /a/ vowels and the /ou/ diphthong (Table 4). According to the multiple-range test, there was a significant difference between the E-S and M-E groups in mean fundamental frequency of the /o/ vowel and the /ou/ diphthong. Differences between the A-E group and the other two groups did not reach significance. The M-E group differed significantly from the other two groups in fundamental frequency of the /a/ vowel. The difference between the A-E and E-S groups was not significant.

TABLE 4
SUMMARY OF MEAN FUNDAMENTAL FREQUENCY MEASUREMENTS AND STANDARD DEVIATIONS OF THE THREE GROUPS OF 18 SUBJECTS EACH AND *F* SCORES DERIVED FROM THREE-WAY ANALYSES OF COVARIANCE WITH NONLANGUAGE *IQ* AS THE COVARIATE

	E-S		A-E		M-E		
Vowel	Mean	*SD*	Mean	*SD*	Mean	*SD*	*F*
o	209.44	20.71	215.56	18.85	195.56	51.59	1.69
oo	204.44	18.86	186.11	24.04	180.0	47.53	2.63
ah	202.22	24.63	202.22	19.27	201.11	21.11	0.097
er	191.11	24.94	178.89	19.97	181.11	17.45	2.18
u	208.89	23.98	204.44	14.64	198.89	24.23	1.48
e	200.0	19.4	191.11	15.3	186.67	19.4	3.41*
ou	199.44	18.93	186.67	20.58	182.22	23.65	3.7*
a	193.33	13.72	181.11	17.45	177.78	21.57	4.1*
ai	201.67	20.07	198.89	21.1	188.89	33.76	1.0
i	193.89	19.74	184.44	21.2	183.33	18.47	1.69
Schwa	188.89	18.44	175.56	18.86	174.44	21.48	3.1
aw	191.11	23.98	184.44	25.26	177.78	22.64	1.38

* Significant at the .05 level of confidence.

D. DISCUSSION

It appears that in certain areas of linguistic functioning, children who spoke only English when they entered kindergarten excel Mexican-American children who learned both English and Spanish before entering kindergarten. This is in accord with earlier research which seemed to indicate that monolinguals excel bilinguals in linguistic functioning. Findings of the present study are also comparable to those of more recent investigations, such as Carrow's study (1957). The present investigation, like Carrow's, found no significant differences in silent reading vocabulary or spelling. The present investigator, like Carrow, found significant differences in oral reading accuracy and comprehension and in articulation. Carrow, whose study was done with third-grade subjects, suggested that a study done with subjects at a higher grade level might reveal that monolingual children would excel bilingual children in reading vocabulary. The present study failed to substantiate this. However, a significant difference was found in favor of the monolingual subjects in silent reading comprehension, whereas Carrow's did not.

It would appear then that the language handicap of Mexican-American children who learn two languages before starting to school does not diminish as the children mature and progress in school. This is not in accordance with conclusions that have been drawn from studies done with college student bilingual subjects (Spoerl, 1944; Black and Grinder, 1959). It may be that bilingual college students equal or excel monolingual students, not because the language handicap disappears by late adolescence, but because such language handicap is less likely to be present among higher *IQ* children and perhaps children of a higher socioeconomic status.

In the acoustic measurements of vowels, there were relatively few differences among the groups. Of special note, in the finding for a few vowels, the monolingual Mexican child differed significantly from each of the other two groups. For the same vowels, bilingual children did not differ significantly from Anglo children who had spoken only English. Any explanation of these results is speculative. These obtained differences may be artifacts. It *may* be, however, that they reflect an occasional "hypercorrect" characteristic of people who have worked diligently to overcome a foreign dialect and have gone to extremes. This characteristic may be like that of the speech of a foreign speaker who has at last learned not to say "hum" for "home," and now says "tol" for "tool." In any case, it is suggested that not all speech and language problems of Mexican-American children are overcome by emphasizing to foreign parents that they should teach their children only English at preschool age.

The results of this study cannot be assumed to be due to bilingualism *per se*. Language characteristics of the subjects may have been due largely to unknown ethnic factors in the environment. The justification for the present study is that it is important to recognize and analyze the problems of children of this two-language environment. Generalizations based on present results should be made cautiously. In the setting of this study, Mexican-Americans constitute a minority. They live among Anglo-American neighbors of comparable socioeconomic status. Results might have been different if the subjects lived in almost entirely Mexican-American neighborhoods.

The following educational implications seem to be justified.

1. School personnel need to be made aware of special language problems of children of this two-language environment.

2. Consideration should be given to providing a special program in language training to children of this environment. A program of speech stimulation and language development should be undertaken at the kindergarten level and

should be followed with training in the production of both vowels and consonants.

There is a practice in the schools to forego speech correction for kindergarten children until they are older. The reason is that often the kindergarten child's speech "defect" is really quite normal for his age and may vanish by the time he is seven or eight years old. It appears, however, that many children of this English-Spanish environment continue to have defective articulation. Also, delay in other areas of language development continues as they advance in school.

3. In the elementary grades, special attention should be given to these children in vocabulary development, reading, and mechanics of English. Included also should be articulatory correction, wherever necessary, and training in inflection.

Suggestions for future research might well include the following:

1. The linguistic function of children who speak Spanish and English and who live in a solidly Mexican-American neighborhood might well be compared with that of Mexican-Americans in the same environment who speak only English.

2. Similar research should be undertaken, using subjects in only the higher *IQ* brackets.

3. Further surveying should be done of characteristics of the Mexican-American culture. Included should be living habits, child-rearing practices, amount and nature of the formal education of the parents, and many other factors.

E. SUMMARY

Three groups of children were compared in certain linguistic functions: Mexican-American children who had spoken both Spanish and English before entering kindergarten; Anglo-American children who had spoken only English; and Mexican-American children who had spoken only English. The groups were matched in nonlanguage *IQ*, chronological age, grade, sex, and socio-economic status. Major findings were as follows:

1. There were no significant differences among the groups in silent reading vocabulary, total silent reading, spelling, or phonemic discrimination.

2. There were significant differences, in favor of the monolingual subjects (both Mexican-American and Anglo-American), in silent reading comprehension, oral reading accuracy and comprehension, inflection, and general language development. The monolingual subjects made fewer errors in consonant articulation.

3. In the acoustic measurements of certain vowels, the bilingual Mexican-American subjects differed significantly from the other groups. In measurements of certain other vowels, the monolingual Mexican-Americans differed significantly from the other groups.

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THE EFFECT OF INCENTIVES UPON INFORMATION GATHERING IN DIAGNOSTIC PROBLEM SOLVING*[1]

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A. INTRODUCTION

There is now such a wealth of data showing that the use of meaningful incentives can bring about improvement of the performance of children in a great variety of tasks that one is tempted to conclude that use of an incentive is universally beneficial. However, on theoretical grounds, one would expect that incentive should induce improved performance only in those instances in which the correct response is at high strength relative to competing responses; where competing responses—which lead to error—are at high strength relative to the correct response, one would expect the use of a meaningful incentive to lead to poorer performance. Where motivation intrinsic to the task itself is already high, little improvement contingent upon the introduction of incentives would be expected.

The task employed in the present experiment is a relatively difficult one for children. Rather, it would be more accurate to say that although the problem can be solved in a variety of ways, optimal solution performance is relatively uncommon, especially among younger children. The task is a paradigm of the diagnostic problem-solving situation in which *S* is confronted with an initial state of affairs, or problem, which may have a finite number of solutions; and his task is to determine a unique correct solution by gathering information with which to eliminate inappropriate alternative solutions. A simplified version is shown in Figure 1. The *S* is given an answer sheet containing *n* numbered patterns each composed of *k* binary elements (black or white circles), and a problem board in which one of those patterns is concealed under *k* movable shutters, one over each element. His task is to identify the concealed pattern by uncovering as few of its elements as possible. Figure 1

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shows four patterns of four elements and a board with a shutter over element B opened to reveal a white circle below.

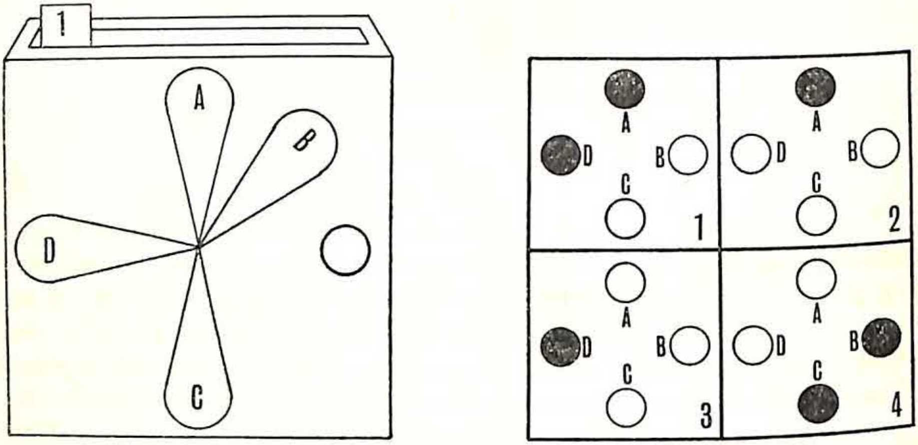

FIGURE 1

SCHEMATIC OF A PROBLEM BOARD WITH FOUR SHUTTERS AND AN ARRAY OF FOUR PATTERNS, ONE OF WHICH IS CONCEALED IN THE BOARD

The shutter at B is opened revealing a white circle below. Thus, patterns 1, 2, or 3 might be the correct answer, but 4 is not. In this instance, as in all the experimental problems, gambling is not rewarded.

The total information required to identify one from among n patterns is measured in terms of uncertainty, H, and $H = \log_2 n$. Thus, for the example in Figure 1, two bits of information are required for solution; for the experimental problems employed, three bits of information were required. The potential information available to S is completely determined by the structure of the patterns on his answer sheet. The information he actually does obtain may be quantitatively described in terms of expected reduction in uncertainty. For brevity, the term *strategy score* will be used to describe S's actual information-gathering behavior as expressed in terms of mean expected informational outcome (in bits) of a series of shutter openings (moves). To see how this score is obtained, consider the four patterns in Figure 1. By opening shutters A or D, S will eliminate two of the four patterns as possible answers regardless of the state of the concealed element; such moves have an expected informational outcome of one bit of information and will be called *safe moves.* By opening shutter B or C, on the other hand, S will have solved the problem (and obtained two bits of information) if the concealed element is black, but will have eliminated only one alternative (gotten .415 bits of information) if it is not. A move of this sort will be called a *gamble*. Its expected informational outcome, E, is obtained by weighting each informational outcome by its likelihood of occurrence (assuming that patterns are equally likely to be concealed in the board): $E = .25\ (2\ \text{bits}) + .75\ (.415) = .811$ bits. These values may be obtained directly from tables of $p \log_2 p$.

The strategy score is obtained by summing the expected informational outcome, E_1, of each successive move over all i moves and dividing the sum by the number of moves. The maximal possible value is unity, which can result only from a series of safe moves; this will be called a *safe strategy*. The strategy score is lowered either by gambling (and, generally, the earlier in a series of moves *S* gambles the more the score is lowered) or by making noninformative (redundant) moves. An example of a redundant move in Figure 1 would arise if *S* opened shutter C after first having opened shutter B (or *vice versa*). In the experiment to be reported *S* was never rewarded for gambling (i.e., only those patterns that had no one-move solution were concealed in the board). The optimal solution procedure was, thus, a safe strategy.

Normally, younger children solve as though they were opening shutters more or less randomly; with increasing mental age they are increasingly likely to develop a safe strategy (1). One essential step in the development of a safe strategy is discovering that moves differ with respect to their potential consequences: e.g., as first moves, some moves are safe moves and some are gambles. In earlier work with adults, who learn this discrimination quite early in a series of problems, the authors found (2) very little effect of a monetary incentive whose total amount was contingent upon *S*s problem-solving performance. In that experiment control and incentive *S*s were given one of a variety of problem series in which either a safe strategy or gambling on the first move would maximize the expected monetary reward. Regardless of the problem series, incentive *S*s (who could earn up to $1.60) did not differ significantly from control *S*s in their information-gathering strategy, although they did take longer to do a series of problems. It is possible that for affluent college students the motivation induced by the intrinsic interest of the task was not appreciably increased by relatively trivial amounts of money.

With children, on the other hand, one might expect the prospect of a monetary reward might increase their attempts to solve in one move: i.e., gamble, a response that is incompatible with the optimal procedure for this experiment—i.e., a safe strategy. However, this effect could only occur for children who select moves according to their potential consequences instead of opening shutters randomly. Thus, it is reasonable to expect that (*a*) monetary incentive will have a detrimental effect and (*b*) this effect will be increasingly prominent among older *S*s.

B. Method

1. *Subjects*

Forty-four boys and girls were selected from the fourth-, fifth-, and sixth-grade students at the La Monte and Lafayette schools of Bound Brook, New Jersey. These children were all white and generally from a lower-middle-class background. To complete the 12-year groups, four children from the Ethel Road school in Piscataway were run; one of these was Negro. All *S*s were of normal intelligence as defined by a Lorge-Thorndike verbal scale *IQ* between 87-115 (for Ethel Road *S*s, an Otis *IQ* was available).

There were 16 children at each age level (10, 11, 12) half of whom were randomly assigned to incentive groups, while the other half were run under control conditions.

2. *Apparatus*

The experimental series of problems consisted of eight problems, each of which was done with a different answer sheet. The answer sheet contained eight patterns of eight binary elements. Each answer sheet was so constructed that, as a first move, half of the available moves were safe moves and the remaining half were gambles. All gambles were correlated: i.e., would "pay off" on the same pattern. That pattern was never concealed in the board; thus, gambling would never be successful on any problem. Each of the answer sheets was a variant of a prototype obtained by permuting (*a*) shutter positions within a pattern and (*b*) arrangement of patterns on a page. Thus, they were physically different in appearance but alike in principle. Order of administration of the problems was varied in an 8 × 8 Latin Square with one *S* of the group assigned to each order.

Eight problems, each on a tabbed cardboard square, were loaded in a nine-inch-square wooden board with eight movable shutters equally spaced around the circumference of a circle eight inches in diameter.

3. *Procedure*

The task was first demonstrated to *S* with an example in which there were four patterns and a problem board with three shutters. *E* opened one shutter and, after asking *S* to eliminate the patterns that were no longer appropriate, asked him which shutter should be opened next. Of the two remaining moves one was noninformative, while the other would solve the problem; regardless of *S*'s choice this fact was pointed out to him. The *S* was then given a series of four or five practice problems to familiarize him with the details of the procedure. For the practice problems the problem board was a standard manila file folder with a black or white circle concealed beneath each of four shutters. The answer sheets contained six (for the first two problems) or eight (for the remainder) patterns of four circles. After having mastered the mechanics of the procedure, *S* began the series of eight experimental problems; an explanation of the incentive conditions was given to the experimental group at this time. On opening a shutter *S* was to record that fact in writing and to designate its position on the appropriate line of his answer sheet and across the face of all patterns thereby eliminated as possible solutions. On attaining a solution he was to write its identifying number on the line labeled "answer." The *E* then closed all shutters; removed the problem from the board; and, for the incentive *S*s only, gave *S* the amount he had won on that problem. *S* then went to the next problem and its accompanying answer sheet. Upon completion of the last problem *S* was questioned about his procedure for solving and was given the Kagan Conceptual Style Test. He was then thanked for his participation and returned to his classroom.

For the incentive groups, each *S* was given four pennies at the outset and told that for each shutter opened he would be charged one-half cent. If the problem were correctly solved, he would win four cents; thus, his net gain would be four cents minus one-half cent for each shutter opened. *S* was given his net winnings (or losses in the case of an incorrect solution) at the end of each problem. Control *S*s simply did the eight experimental problems.

C. RESULTS

Table 1 summarizes data on the incentive and control groups for each age level. As may be seen from the first two columns of Table 1, the groups are fairly well equated for intelligence and comparable in age at each age level. If *S*s solved their eight problems optimally they would solve in three moves and with a strategy score of 1.00. Although strategy scores do show a significant improvement over trials: $F(7,294) = 2.143$, $p < .05$, it is clear that all groups are still far from optimal performance. There are no statistically significant differences in rate of improvement of strategy scores as a function either of age, incentive, or their interaction. In the case of number of moves, older *S*s solve in significantly fewer moves than younger ones, $F(2,42) = 2.680$, $p < .05$, but incentive differences are not statistically significant.

Since there is a consistent suggestion of lower strategy scores in the incentive groups than the control groups, with differences between comparable experimental and control groups increasing among older *S*s (as was predicted), finer details of performance were examined to determine what factors con-

TABLE 1

GROUP MEAN AND STANDARD DEVIATIONS (IN PARENTHESIS) FOR AGE, VERBAL *IQ*, NUMBER OF MOVES TO SOLUTION, STRATEGY SCORE, TOTAL NUMBER OF ERRORS, TOTAL NUMBER OF REDUNDANT MOVES, NUMBER OF SAFE STRATEGIES, PER CENT OF SAFE FIRST MOVES, AND NUMBER OF CORRECT OR PARTIALLY CORRECT STATEMENTS OF RULE

	Group mean and standard deviation					
	Control group			Incentive group		
Measure	10	11	12	10	11	12
Age	10.53 (.37)	11.27 (.22)	12.15 (.39)	10.55 (.35)	11.33 (.41)	12.23 (.24)
Verbal *IQ*	104.5 (8.32)	104.2 (9.24)	103.8 (4.13)	106.6 (6.33)	103.5 (9.73)	102.4 (6.95)
Moves per problem	5.30 (1.14)	4.48 (1.14)	4.12 (1.14)	5.39 (1.39)	4.84 (1.33)	4.53 (0.93)
Strategy score per problem	.6842 (.165)	.7669 (.154)	.8342 (.150)	.6446 (.159)	.7297 (.174)	.7567 (.137)
Total errors[a]	5	5	7	7	2	5
Total redundant	107 (8.21)	71 (7.27)	49 (8.16)	126 (10.52)	90 (8.56)	69 (7.16)
No. safe strategies[a]	11 (1.87)	22 (2.33)	26 (1.85)	10 (.148)	17 (2.26)	13 (1.22)
Prop. safe first moves[b]	.562 (1.94)	.672 (1.22)	.750 (1.58)	.453 (.86)	.781 (1.20)	.562 (1.50)
No. full correct rules	1	2	2	2	1	0
No. full or partial[c]	3	3	3	2	3	2

[a] Based on 64 problems, eight per *S*.

[b] Standard deviation based on number rather than proportion.

[c] Partially correct rule is a limited (usually to the last move) statement of the correct rule.

tribute to differences in information-gathering behavior. For one thing, incentive, *S*s seem to be making more noninformative moves although differences in frequency of such moves are not statistically significant. Similarly, although the proportion of safe first moves increases with age, *S*s in the incentive groups seem to be doing more first-move gambling than control *S*s. Comparable differences appear in the overall frequency of safe strategies. In the case of both safe first moves and safe strategies, however, differences between incentive and control groups are not statistically significant (although a χ^2 comparison shows significantly fewer safe strategies among the incentive groups for the 12 year olds: $\chi^2 = 4.39$). Thus, although the data are compatible with the prediction that incentives serve to increase the likelihood of erroneous competing responses—especially among older *S*s—none of the data achieves acceptable levels of statistical significance.

Finally, in all groups very few *S*s verbalize a full correct rule for information gathering at the end of the experiment, although data on number of safe strategies indicate that a number of *S*s are in fact employing it. Once again, there seem to be no differences between incentive and control *S*s with respect to formulation of a rule: i.e., description of a safe strategy.

D. DISCUSSION

Although there are suggestions of the predicted detrimental effect of incentive conditions upon information gathering behavior, for none of the response measures examined is that effect statistically significant. This finding supports earlier evidence for adult *S*s run with the same problem series and a number of incentive conditions (2). However, aside from the obvious error of asserting the null hypothesis, the authors are hesitant about concluding that variation of incentive conditions does not affect children's information-gathering strategies in diagnostic problem solving.

The age range of the present experiment was chosen on the basis of earlier evidence (1) that it is about this age range that children begin to shift from more or less random shutter opening to rational information-gathering strategies. Typically this increasing rationality is reflected in a number of measures: (*a*) a decreasing frequency of noninformative moves and a concomitant tendency to (*b*) choose later moves so that they will discriminate among the remaining possible solutions. This latter tendency generalizes to earlier moves with the result that children discriminate gambles from safe moves; and, finally, not only seek a safe move at each step of the solution process, but also are able to describe this process as a rule of procedure. There is clear evidence in the present data that with increasing age *S*s are increasingly rational in their information gathering, but within any one age group there are children at all levels of the process of developing strategies at higher levels of abstraction. Thus, within-group variability tends to be so great as to obscure subtle between-group differences. One cannot, therefore, exclude the possibility that with larger groups, or longer problem series, or a group of still older children (or various combinations of these variables), the relatively subtle effects of incentive variation might be reflected.

Finally, perhaps a word about the presumed "subtlety" of incentive effects is in order. It is our impression that the task itself (and for that matter, any successful intellectual activity) is so intrinsically rewarding to children that additional extrinsic incentives can do little to increase motivation. Generally, it is the case that extrinsic incentive effects are most readily demonstrated in a task that is simple, relatively meaningless, and dull: e.g., operant conditioning

(4) or probability learning (3). This observation, in turn, suggests that any generalization about the effect of incentive will have to be contingent upon such other variables as properties of the experimental task and the kind of response hierarchies to which it gives rise.

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RELATIONSHIPS AMONG ATTITUDES IN PREGNANCY AND OTHER MATERNAL CHARACTERISTICS*

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A. INTRODUCTION

The present investigation represents an attempt to relate expressed attitudes in pregnancy, including attitudes reflecting emotional adjustment, to a variety of maternal characteristics. Recent evidence suggests that maternal attitudes during pregnancy successfully predict such variables as postnatal offspring behavior and maternal health during and after pregnancy. Further information regarding correlates of maternal attitudes in pregnancy appears necessary to an understanding of these attitudes. The present study extends attitude comparisons to include the following as variables: trimester of pregnancy, social class, personality characteristics, as well as child-rearing attitudes and maternal opinions regarding offspring behavior.

Several investigations have been conducted on relationships between expressed anxiety in pregnancy and other variables. Davids *et al.* (2, 3) found that pregnant women who later experienced delivery complications, and women whose offspring later exhibited physical abnormalities tended to make higher scores on the Taylor Manifest Anxiety Scale (MAS): that is, they exhibited greater anxiety than did subjects whose deliveries and infants were normal. In addition, these authors (3) observed a relationship between maternal anxiety during pregnancy and quality of offspring's emotional development evaluated at eight months postnatally. Mothers making high MAS scores while pregnant tended to have infants who displayed less favorable intellectual and emotional development than did "low anxiety" subjects although differences in offspring behavior did not reach significance.

Another group of researchers (15) observed that number and severity of somatic complaints correlated positively with MAS scores, as well as with scores on the Parental Attitude Research Instrument (PARI) Marital Conflict scale and also with history of menstrual difficulties. Anxiety, as measured by the Affect Adjective Check List, was also significantly related to amount of analgesic required by patients during labor.

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No significant correlations were observed by Zuckerman between anxiety and length of labor, in contrast with findings of Davids *et al.* (3) and those of Zemlick and Watson (14). Zemlick and Watson found a relationship between rejection of femininity, of sexuality, of marital status, and of motherhood during pregnancy and evidence of maternal behavior after delivery. Rejection was assessed by means of Thematic Apperception Test (TAT) stories, judges' ratings, and sentence completions. These investigators hypothesized that rejecting attitudes toward offspring are frequently expressed in overprotective maternal behaviors.

In related research, Ferreira (5) used a 64-item questionnaire based on PARI items to determine relationships between various maternal attitudes in pregnancy and infant behavior during the first five days of postnatal life. Some antecedents of infant irritability, crying, and other deviant behavior were observed. Unusual neonate behaviors of these types were associated with a maternal attitude of "fear of harming the baby" and with extreme scores on "rejection of pregnancy" scale items. In the study by Davids (3), significant differences were obtained by high and low anxious mothers in pregnancy and scores after delivery on the PARI hostility and control scales.

In the present study, a short attitude scale designed to reveal attitudes toward pregnancy was developed initially on a group of married, middle-class women. It was subsequently administered to a second group of similar subjects and to a group of married lower-class women. Information regarding this scale will be presented first. A checklist of maternal opinions of offspring behavior was also developed and will be described next. Finally, relationships between scores on these two scales and on the Minnesota Multiphasic Personality Inventory (MMPI), MAS (13) and PARI (8) will be discussed.

B. METHODS

1. *Subjects*

The sample consisted of 200 *S*s obtained through the cooperation of various women's organizations in the suburban Chicago area. All subjects were contacted by mail. Women were administered the Pregnancy Attitude Scale (PAS) and MMPI during their third trimester of pregnancy (eighth to ninth month). At this time they also completed a questionnaire covering background information including age, income, number of previous pregnancies, etc. When offspring were about six months old, the Offspring Behavior Checklist (OBC) and PARI were administered. Approximately 85 per cent of the original subjects contacted returned responses to all tests. Ten per cent of these were eliminated because of incomplete data, histories of abnormal pregnancies, or because PAS or MMPI validity scales indicated scores on these tests were of unacceptable validity. Subjects were assigned to middle- or lower-class groups on the basis of Hollingshead's Index of Social Position. Social class groups were further subdivided into primiparous and multiparous groups.

2. *Materials*

Maternal attitudes in pregnancy were assessed by means of a short inventory, the PAS. This instrument consists of 60 yes-no items pertaining to five subscales and a 10-item lie scale. All subscales consist of 10 items. The scale items were selected to represent a variety of aspects of attitudes toward pregnancy. Scales are designated: 1—emotional disturbance (including irritability and depression); 2—physical symptoms of pregnancy; 3—rejection of pregnancy; 4—rejection of maternal role; 5—fear of pregnancy and childbirth. Lie scale items were selected on the basis of unanimous agreement among judges that certain responses to these items would probably constitute lies (i.e., I never feel uncomfortable). A score is obtained for each subscale by summing responses to items keyed for unfavorable attitudes. Half the responses keyed to unfavorable attitudes are yes items. High scores on each scale indicate unfavorable attitudes toward pregnancy.

A search of the literature has indicated the need for a brief screening instrument for assessing infant behavior. Therefore, a maternal checklist of infant behavioral and health problems (OBC) was developed on the sample in the present investigation. The OBC consists of 80 yes-no items pertaining to four subscales: general health, feeding behavior, sleeping patterns, and crying. Each subscale consists of 20 items. Items were selected from the literature on infant behavior scales and from comments of judges mentioned above. Scores on each subscale are obtained by summing responses to items keyed for unfavorable behavior. High scores on each subscale indicate that the infant, in the mother's opinion, exhibits difficulty in the behavioral area in question.

C. RESULTS

Data were analyzed by means of Pearson product-moment correlations among all test scores. PAS and OBC scores were analyzed by subscale, social class, and number of previous pregnancies in separate factorial analyses of variance. Duncan Multiple Range Tests (4) were applied to determine significant differences among group means.

1. *Pregnancy Attitude Scale*

Internal consistency reliabilities ranged from .82 for Subscale 2 (physical symptoms) to .62 for Subscale 1 (emotional disturbance). Intercorrelations among subscales were positive and highly significant for all groups, indicating close relationships among the variables of emotional disturbance, physical symptoms of pregnancy, rejection of pregnancy and maternal role, and fear of pregnancy and childbirth.

A 5 × 2 × 2 factorial analysis of variance of PAS scores obtained by all Ss yielded significant F values for main effects of subscale ($F = 5.62$, $df = 4/191$, $p < .01$), as well as for interactions between subscale and number of previous pregnancies ($F = 10.09$, $df = 4/191$, $p < .01$), subscale × social class ($F = 4.51$, $df = 4/191$, $p < .01$), and subscale × number of previous pregnancies × social class ($F = 7.89$, $df = 4/191$, $p < .01$). Mean PAS scores for all Ss are presented in Table 1.

TABLE 1
MEAN PAS SCORES OBTAINED BY ALL SUBJECTS

	Group			
PAS subscale	Middle-class primiparae	Middle-class multiparae	Lower-class primiparae	Lower-class multiparae
1—emotional disturbance	4.26	4.02	6.93	8.96[a]
2—physical symptoms	7.30	6.85	5.02	3.18[a]
3—rejection of pregnancy	2.42	3.14	4.04	7.18[a,b]
4—rejection of maternal role	3.46	8.66[b]	4.60	8.82[b]
5—fear of pregnancy and childbirth	5.44	2.10[c]	4.28	2.64

[a] Significantly different from means for middle-class Ss ($p < .01$).
[b] Significantly different from means for primiparae Ss ($p < .01$).
[c] Significantly different from mean for middle-class primiparae Ss ($p < .01$).

Scores on Subscale 1 (emotional disturbance) and Subscale 4 (rejection of maternal role) were significantly larger than those obtained on Subscale 5 (fear of pregnancy and childbirth). Inspection of Table 1 reveals that social class significantly affected attitudes reflecting emotional disturbance, physical symptoms (Subscale 2), and rejection of pregnancy (Subscale 3). Middle-class Ss endorsed significantly fewer items indicating emotional disturbance and expressed significantly less rejection of pregnancy than did lower-class women. However, middle-class Ss had significantly more physical symptoms of pregnancy than did the latter Ss.

Number of previous pregnancies significantly affected attitudes of rejection of pregnancy, rejection of maternal role, and fear of pregnancy and childbirth. However, significant interactions between social class and number of previous pregnancies were found for all subscales except Subscale 5 (fear of pregnancy and childbirth). Lower-class multiparae expressed significantly greater rejection of pregnancy and maternal role than did other groups. Both middle- and lower-class multiparae expressed significantly greater rejection of pregnancy and significantly less fear of pregnancy and childbirth than did primiparae.

Mean numbers of previous pregnancies and ages of all groups of *S*s are presented in Table 2. Application of Duncan Multiple Range Tests to differences among means yielded significant differences in number of previous pregnancies and age only between multiparae and primiparae. Social class groups did not differ on these variables. Therefore, any attitudinal differences between social class groups cannot be attributed to differences in age or number of previous pregnancies.

TABLE 2

MEAN AGES AND NUMBER OF PREVIOUS PREGNANCIES OF ALL SUBJECTS

Variable	Middle-class primiparae	Middle-class multiparae	Lower-class primiparae	Lower-class multiparae
Mean age	20.8	31.3[a]	19.2	28.3[a]
Mean number of previous pregnancies	0	3.2[a]	0	4.3[a]

[a] Significantly different from means for primiparae *S*s ($p < .01$).

2. *Offspring Behavior Checklist*

Internal consistency reliabilities of OBC subscales range from .76 for Subscale 4 (crying) to .44 for Subscale 1 (physical health). Significant positive intercorrelations were obtained for all groups among Subscales 2 through 4 with the exceptions of Subscales 2 (feeding) and 4 (crying) for lower-class multiparae. Scores on Subscale 1 (physical health of infant) were not highly correlated with other subscale scores for any group. Items on this scale referred to such variables as presence of deformities and incidence of colds and more serious illnesses.

OBC scores were analyzed by means of a 4 × 2 × 2 factorial analysis of variance. Significant F values were obtained for subscale ($F = 4.83$, $df = 3/191$, $p < .01$), and interactions between subscale and social class ($F = 6.48$, $df = 3/191$, $p < .01$), as well as between subscale and number of previous pregnancies ($F = 9.76$, $df = 3/191$, $p < .01$), and subscale × social class × number of previous pregnancies ($F = 7.57$, $df = 3/191$, $p < .01$). Mean OBC scores obtained by all *S*s are presented in Table 3.

TABLE 3
MEAN OFFSPRING BEHAVIOR CHECKLIST SCORES FOR ALL SUBJECTS

	Group			
OBC subscale	Middle-class primiparae	Middle-class multiparae	Lower-class primiparae	Lower-class multiparae
1—general health	12.78	10.54	11.54	3.80[a,b]
2—feeding	9.24	6.63[c]	8.69	3.98[a,d]
3—sleeping	8.40	6.52	7.63	3.58[c]
4—crying	7.54	5.84	7.25	4.02[c]

[a] Significantly different from primiparae means ($p < .01$).
[b] Significantly different from middle-class *S*s means ($p < .01$).
[c] Significantly different from primiparae means ($p < .05$).
[d] Significantly different from middle-class *S*s means ($p < .05$).

Scores on Subscale 1 (general health) were significantly higher for all groups combined than scores on other subscales. Most of the variance in scores was attributable to lower-class multiparae who listed fewer infant problems of all kinds than did other *S*s. Also, primiparous *S*s of both social classes obtained higher scores on all subscales than did multiparous *S*s.

3. *PAS-OBC Relationships*

Significant PAS and OBC intercorrelations are presented in Table 4. Intercorrelations among PAS subscales 1 through 4 and all OBC subscales tend to be positive and significant for all groups except lower-class multiparae. An exception to this was the correlation between infant's health and mother's rejection of maternal role, which was not significant except for lower-class multiparae. Among the latter group, only OBC subscales pertaining to physical health and crying were positively correlated with all PAS subscales.

4. *PAS-MMPI and MAS Relationships*

Significant PAS-MMPI and MAS intercorrelations are presented in Table 5. Correlations between PAS subscales and combined scores on MMPI Clinical Scales 1, 2, and 3 are given, as scores on the latter measures were similar. Scores on PAS Subscale 2 (physical symptoms) were positively related to MMPI neurotic triad scale—hypochondriasis (*Hs*), depression (*D*), and hysteria (*Hy*)—scores and to MAS scores for all groups. Scores on PAS Subscale 1 were correlated with scores on the above MMPI scales only among

TABLE 4
SIGNIFICANT OBC-PAS INTERCORRELATIONS

	PAS				
OBC	1	2	3	4	5
			Middle-class primiparae		
1	.345*	.425**	.331*		.297*
2	.621**	.668**	.429**	.566**	
3	.626**	.690**	.517**	.551**	
4	.609**	.683**	.395**	.557**	.341*
			Middle-class multiparae		
1	.302*	.347*	.388**		
2	.664**	.618**	.671**	.449**	.349*
3	.505**	.671**	.724**	.528**	.425**
4	.598**	.537**	.608**	.308*	
			Lower-class primiparae		
1	.364**	.431**	.382**		
2	.776**	.765**	.572**	.580**	.508**
3	.772**	.740**	.599**	.545**	.425**
4	.637**	.749**	.543**	.487**	.488**
			Lower-class multiparae		
1	.469**	.602**	.440**	.430**	.391**
2					
3	.540**	.443**	.442**	.426**	.677**
4	.343*				.511**

* $p < .05$ ($r = .273$).
** $p < .01$ ($r = .354$).

middle-class *S*s, while PAS Subscale 5 scores were correlated with scores on these MMPI scales and with MAS scores only among primiparae.

Scores on PAS Subscales 1, 3, and 4 were positively related to scores on the MMPI clinical scale Schizophrenia (*Sc*) for all groups except lower-class multiparae. However, scores on the MMPI Hypomania (*Ma*) scale were not significantly related to PAS scores. Scores on PAS Subscales 1, 3, and 4 were also significantly correlated with MMPI scores on the psychopathic deviate (*Pd*) scale for middle-class *S*s. Correlations among PAS and MMPI scales were lowest among lower-class multiparae, as MMPI *Pd* and *Sc* scores were elevated for this group.

5. *PAS-PARI Relationships*

Significant PAS and PARI intercorrelations are presented in Table 6. Scores on PAS Subscale 2 were significantly correlated with scores on PARI scales reflecting maternal dependency (fostering dependency, fear of harming the baby, avoidance of communication, and dependency of mother) for all groups. PAS Subscale 5 scores were correlated with scores on these PARI

TABLE 5

SIGNIFICANT CORRELATIONS AMONG PAS SCORES, MMPI, AND MAS SCORES FOR ALL SUBJECTS

PAS subscale	MMPI and MAS scores							
	Hs(1), D(2) and Hy(3)				Sc(8)			
	M-CP[a]	M-CM[b]	L-CP[c]	L-CM[d]	M-CP	M-CM	L-CP	L-CM
1	.347*	.333*			.465**	.437**	.532**	.343*
2	.363**	.421**	.478**	.537**				
3					.459**	.356**	.666**	.330*
4					.548**	.340*	.314*	
5	.289*		.324*					

TABLE 5 (*continued*)

PAS subscale	MMPI and MAS scores MAS M-CP	 M-CM	 L-CP	 L-CM	 Pd(4) M-CP	 M-CM	 L-CP	 L-CM
1								
2	.543**	.495**	.410**	.574**				
3					.289*	.276*		
4	.362**		.472**		.324*	.306*		
5	.371**		.402**					

* $p < .05$ ($r = .273$).
** $p < .01$ ($r = .354$).
[a] Middle-class primiparae group.
[b] Middle-class multiparae group.
[c] Lower-class primiparae group.
[d] Lower-class multiparae group.

scales only among primiparous groups. Among middle-class subjects, PAS Subscale 2 scores were significantly related to PARI hostility and control-factor-scale scores. PARI hostility-factor-scale scores (marital conflict, irritability, and rejection of homemaking role) were highly correlated with PAS Subscale 1, 3, and 4 scores for all groups. Scores on PARI control factor scales (ascendency, intrusiveness, and deification) were positively correlated with scores on the above PAS subscales among all groups except lower-class multiparae.

D. Discussion

Attitudes toward pregnancy vary as a function of social class membership and previous pregnancies. Lower-class women, particularly multiparae, admit more emotional disturbance and express greater rejection of both pregnancy and maternal role than do other groups of *S*s. Also, the former admit to fewer physical symptoms of pregnancy. However, all these variables are positively correlated for all groups tested.

Infant problems of sleeping, eating, and crying are interrelated, at least in opinions of mothers. More importantly, attitudes in pregnancy are predictive of opinions regarding infant behavior problems. Negative attitudes in pregnancy are positively correlated with number of infant problems among all groups except lower-class multiparae, who express the most negative attitudes in pregnancy and report fewest infant behavior problems. These class differences in maternal opinions of infant behavior may reflect actual differences in infant behavior. An alternative explanation is that lower-class multiparae are less attentive to or more repressive regarding the infant behavior about which they were questioned than are other multiparae.

Primiparae, who admit significantly more fear of pregnancy and childbirth and greater maternal dependency, report more infant problems than do multiparous *S*s. These findings are in agreement with results of other research (9, 10) and seem to indicate that primiparae are more dependent and anxious regarding their infants and themselves both during and after pregnancy. These relationships can reasonably be attributed to the primipara's lack of experience with the problems of childbearing and rearing.

MMPI and PAS correlations suggest that attitudes in pregnancy reflect basic personality characteristics and not simply temporary behavioral changes brought on by the stress of pregnancy. Rejecting attitudes toward pregnancy and motherhood are associated with high MMPI scores on psychopathic deviate and schizophrenia scales. The woman with psychotic or psychopathic tendencies may almost completely reject her maternal role. She may strongly

TABLE 6
SIGNIFICANT CORRELATIONS AMONG PAS SCORES AND PARI SCORES FOR ALL SUBJECTS

	PARI scores											
PAS	Dependency (scales 2, 6, 16, 23)				Factor B (hostility)				Factor A (control)			
subscale	M-CP[a]	M-CM[b]	L-CP[c]	L-CM[d]	M-CP	M-CM	L-CP	L-CM	M-CP	M-CM	L-CP	L-CM
1					.398**	.378**	.372**	.425**		.321*	.329*	.505**
2	.469**	.283*	.387**	.329*	.296*	.306*			.287*	.296*		
3	.285*				.361**	.467**	.569**	.521**	.306*	.278*	.321*	
4					.321*	.438**	.463**	.467**	.298*	.282*	.437**	
5	.578**		.421**									

* $p < .05$ ($r = .273$).
** $p < .01$ ($r = .354$).
[a] Middle-class primiparae group.
[b] Middle-class multiparae group.
[c] Lower-class primiparae group.
[d] Lower-class multiparae group.

deny physical symptoms of pregnancy and behavioral problems in her infant. Her attitudes during and after pregnancy toward her role appear to be hostile, repressive, and punitive.

Physical symptoms, as well as fear of pregnancy and childbirth, are positively correlated with MMPI neurotic-triad-scale scores, as well as MAS scores. The association among these variables indicates that the physical discomforts of pregnancy may be magnified and fixated upon by the highly anxious woman. If MAS scores are viewed as an index of drive, these findings suggest a motivational basis for some of the physical complications of pregnancy. MAS scores are significantly related to physical symptoms across social classes although the correlations between these variables are probably not high enough to permit high predictive effectiveness. A relationship between physical complaints in pregnancy and MAS scores was also observed by Zuckerman *et al.* (15).

Attitudes in pregnancy also predict subsequent child-rearing attitudes. Attitudes indicating emotional disturbance tend to be significantly correlated with PARI hostility and control factor scales, as do rejecting attitudes toward pregnancy and maternal role. Physical symptoms of pregnancy are significantly related among all groups to PARI scales indicating maternal dependency and to PARI hostility and control factor scales for middle-class women. These data, coupled with the finding that women who express considerable rejection of pregnancy also report more problems with their infants, suggest that some infant behavioral disturbance has its antecedents in certain prepartum emotional and motivational characteristics of the mother. Ferreira's (5) finding that maternal rejection of pregnancy is associated with excessive infant crying is in agreement with these results, and suggests that the infant behavioral disturbance in question is detectable by an outside observer.

The findings that PARI hostility factor scales, including the Marital Conflict scale, are positively correlated with MAS scores and with physical symptoms of pregnancy are in agreement with results of previous research (3, 15). However, these correlations do not appear across all groups: physical symptoms predict PARI hostility factor and MAS scores only for middle-class *S*s. Lack of similar correlations among lower-class *S*s may be due to the fact that the latter women obtained higher scores on PARI hostility factor scales and lower MAS scores than did middle-class *S*s.

About two-thirds of women expressing negative attitudes in pregnancy tend to exhibit one of two patterns of test scores. One group, consisting mainly of lower-class multiparae, is characterized by attitudes of rejection toward pregnancy and maternal role, elevated scores on the MMPI *Pd* scale, and on

PARI hostility factor scales. A second group, consisting largely of middle-class primiparae, is characterized by fear of childbirth and pregnancy, numerous physical symptoms of pregnancy, high MAS scores, as well as elevated scores on PARI scales indicating fostering of dependency, fear of harming baby, avoidance of communication, and dependency of mother. These constellations of responses suggest that rejection of pregnancy has multiple sources and probably is correlated with quite different maternal behaviors. The above two groups correspond somewhat to groups identified by Schaefer and Manneheimer (9).

Reasons for consistent differences between lower-class multiparae and other groups on nearly all variables investigated are not clear. It is possible that this group is less defensive about expressing negative feelings than are other groups. An explanation solely in terms of social class differences is not particularly tenable in view of the fact that attitudes in pregnancy and MMPI scores for this group are similar to those reported for unwed middle-class primiparae (1, 7). Possibly unwed primiparae and lower-class multiparae are subjected to similar stresses or to stresses different from those experienced by other pregnant women.

The interrelationships observed among maternal attitudes in pregnancy, child-rearing attitudes, verbal reports of postnatal infant behavior, and personality characteristics are undoubtedly very complex. One possibility suggested by these data is that maternal attitudes in pregnancy somehow reflect prenatal environmental influences which have considerable consequences for subsequent offspring behavior. Physiological events occurring during pregnancy with long-term effects on later maternal and offspring behavior may be associated with, and predictable from, maternal psychological characteristics in pregnancy. A number of retrospective studies suggest that a variety of behavior and physical disorders in children are associated with abnormal prenatal environments (6, 11, 12). Further theorizing regarding behavioral development may need to include prenatal events as significant influences on postnatal patterns of development.

Possible interactions between prenatal and postnatal maternal variables also require consideration. Effects of maternal emotional stress in pregnancy (reflected in negative attitudes toward pregnancy and deviant personality test scores) may combine additively with postnatal maternal disturbances (indicated by rejecting child-rearing attitudes) and may compound offspring behavioral disturbance. Conversely, infant behavior deviancy may alter maternal behavior and contribute to disturbed mother-child interactions.

The possible consequences of maternal disturbance in pregnancy for later maternal and child behavior also suggest that more serious attention be paid to psychotherapeutic treatment of pregnant women. It would be most useful to determine ways in which psychotherapeutic intervention during pregnancy might influence subsequent maternal behavior and progeny development.

In summary, present findings suggest maternal attitudes in pregnancy are predictive of subsequent attitudes toward offspring behavior and childrearing. These attitudes are consistent enough to suggest that they may serve as useful indicators of postpartum maternal behavior, and possibly of offspring behavior.

Further research is necessary to unravel the wealth of interrelationships implicit in the present data. Additional study is required to determine the predictive validity of the PAS and OBC. Undoubtedly, many variables other than social class and number of previous pregnancies influence maternal attitudes in pregnancy. These variables should be teased out. Relationships among attitudes of pregnant women, delivery complications, and length of labor should be explored, as should attitudinal correlates of offspring behavior beyond early infancy. Finally, an effort should be made to separate effects on offspring behavior of prenatal and postnatal maternal influences.

E. Summary

This article reports the development of a Pregnancy Attitude Scale (PAS) to assess attitudes of expectant mothers and an Offspring Behavior Checklist (OBC) to assess postpartum maternal attitudes. These scales, the PARI and MMPI, were administered to 200 middle- and lower-class pregnant women. Maternal attitudes were found to vary considerably with social class and, to a lesser extent, with previous pregnancy experience. Attitudes were related to certain maternal personality characteristics, and were correlated with postnatal child-rearing attitudes, as well as maternal ratings of postnatal offspring behavior. The data indicated that attitudes during pregnancy may be useful predictors of subsequent maternal and offspring behavior.

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LEARNED REDUCTION OF DRINKING LATENCY*[1]

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A. INTRODUCTION

Investigation of the rat's adaptation to drinking schedules has brought forth two alternative points of view. Ghent (4) suggested that the usual progressive increment of drinking, asymptotic to a limit as a function of days on a water deprivation schedule, is due to learning. Bindra (2) and Cofer (3) have generally agreed with this position, though they presented no further data. On the other hand, Beck (1) has presented data inconsistent with such an interpretation due to the fact that he found only negligible savings from one course of adaptation to a subsequent course. He concluded that learning plays a negligible role in adaptation to a water deprivation schedule.

Another line of evidence that tends to corroborate Beck's physiological adaptation point of view is related to saline induction of drinking in rats in water balance. Wayner and Reimanis (7) found that repeated subcutaneous injections of hypertonic saline did not result in any consistent change in volume ingested. Schmidt (5) reported that response latency remains essentially constant when hypertonic saline is repeatedly injected.

Thus, it would appear that adaptation to a drinking schedule does not lead to learning to respond. The available data suggest that the response to hypertonic saline is not affected by variables that can be brought under the rubric of learning. Nevertheless, a recent series of observations of drinking latency induced by an injection of hypertonic saline, following adaptation to a drinking schedule, showed a reduced response latency as compared with earlier findings. While these observations cannot be regarded as properly controlled, they did suggest that the rat learns something during adaptation to a drinking schedule that it can transfer to another situation. This paper is the product of an attempt to formalize those observations.

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B. EXPERIMENT 1

1. *Apparatus*

The drinking boxes employed in this study have been described previously (6). Basically they consisted of boxes for each rat, a calibrated tube containing water, and a spout from the tube into the box. Doors were also placed in the box to separate the rat from the drinking spout when appropriate.

2. *Animals*

Fifty-four male albino rats of the Holtzman strain were used. In the first experiment 36 rats were used. These animals were about 100 days of age at the start of the experiment. In a second experiment, 18 rats of 130 days of age were used. In this latter experiment, however, only 15 animals survived the procedures. The probable reasons for mortality will be given below.

3. *Procedure*

In this experiment, the animals were divided into three groups at random. These groups were each further subdivided into two further groups, but only for practical, not treatment, purposes. Thus, 36 rats were divided into three groups of 12 rats each. Each of these various groups of 12 rats was further subdivided into two subgroups of six rats. These latter subgroups were housed together in half of one of our standard laboratory cages. This gave each subgroup of six animals a space of 18 inches by 12 inches by 10 inches. Four of the subgroups had water bottles removed and had only controlled access to water, while the other two subgroups of animals had *ad lib* water and served as a control group.

Of the four groups given controlled access to water, two were placed upon a 23-1/2-hour water deprivation schedule. These animals drank their daily ration of water in the drinking boxes described previously. The other two groups were also placed on a 23-1/2-hour water deprivation schedule and were given their daily half-hour drinking period in a standard laboratory cage (36 inches × 12 inches × 10 inches) other than the home cage. All animals in a subgroup were placed in the watering cage at a given time for the drinking period. Four bottles of water were made available to these latter subgroups of six animals.

These various treatments—*ad lib* drinking, 1/2-hour daily drinking in individual boxes with individual drinking bottles, and 1/2-hour daily drinking in a large cage with four bottles for six rats—were maintained for 10 days. After the tenth occasion of half-hour drinking after 23-1/2-hour water deprivation, the animals were all placed upon an *ad lib* drinking schedule in which two bottles were constantly available to six rats. No handling of these animals was done for a week after the return to the *ad lib* schedule.

One week after the *ad lib* schedule was reinstituted for the animals previously deprived, all rats received a 3 ml injection of IM sodium chloride solution. At this time each rat was placed in a drinking box with one tube full of tap water with the doors open, and allowed to drink. It is important to remember that all animals had been given *ad lib* water for at least one week and as a consequence were more or less in water balance. The hypertonic saline imposes an osmotic stimulus which disturbs water balance by producing a relative excess of electrolytes to water: i.e., relative dehydration (8).

Two measures of responding were obtained. The time to initiate drinking was recorded: i.e., the drinking latency, which is defined as that time at which bubbles first appear in the calibrated drinking tube after saline injection. Drinking latency was determined by a stopwatch to the nearest second. In addition, the volume of water ingested in three hours was also recorded. This volume was ascertained to the nearest .1 ml.

4. *Results*

The results of the first experiment were planned to be such as to be relevant to two hypotheses. It was expected that (*a*) rats that had not experienced water deprivation would require a longer time to initiate drinking after saline injection than the animals that had had such experience—i.e., a comparison of the nondeprived animals against the mean of the two groups previously water deprived; and (*b*) the response latencies of the two groups previously deprived would not differ significantly. No expectations were formed as to the significance or direction of any differences relative to the various treatments with regard to amount ingested in three hours. Since previously reported investigations found no effects of previous experience on ingested volume, no predictions were made. The basis for making predictions about effects upon response latency was previous though not satisfactorily controlled evidence. Those data indicated reduction of the time to initiate drinking after a course of adaptation to a restricted drinking schedule as compared with more or less "naive" rats.

The response latency data were transformed into the logarithms of the latencies and analyzed (in terms of the logarithms) by analysis of variance. The geometric mean—i.e., the antilogarithm of the mean logarithm—will be reported here. The mean response latency, for the "naive" control group was 381 seconds. The rats previously water deprived that drank in the drinking boxes gave a comparable value of 245 seconds, while the animals that drank in the group cage after water deprivation gave a value of 292 seconds. A comparison of the difference between means of the latter two groups was insignificant ($F = 1.47$, $df = 1/30$). The analysis of the difference between the control group and the mean of the deprived groups was significant ($F = 8.03$, $df = 1/30$, $p < .01$). Rats with a history of water deprivation initiated drinking more rapidly than nondeprived controls.

Examination of the volumes ingested in three hours indicates a mean intake of 10.5 ml for the nondeprived animals, 13.6 ml for the deprived animals that drank in individual cages, 13.2 ml for the deprived group that drank in the group cage. Analysis of the data similar to that done for response latencies was performed. A comparison between the two previously water deprived groups was quite insignificant ($F = 1.00$, $df = 1/29$). (One observation of ingested volume was lost, which accounts for the loss of one degree of freedom.) A comparison of the mean of animals with no history of water deprivation *versus* the mean of the deprived animals was quite significant ($F = 17.14$, $df = 1/29$, $p < .001$). Animals with a history of water deprivation drank significantly more than the controls in this experiment.

C. Experiment 2

The data from the initial experiment clearly show an effect of prior water deprivation and consequent drinking upon the later response to hypertonic saline. It would be desirable to isolate the effects of water deprivation from the drinking induced by means of deprivation. The experimental plan pursued involved water deprivation without regulation via drinking.

1. *Method*

The second experiment involved two groups of nine rats. Each group was housed in a standard laboratory cage, a space 36 inches by 12 inches by 10 inches. Water bottles were removed from one of these cages. The bottles remained on the other cage and the animals got water on an *ad lib* schedule. Approximately 24 hours after removal of the bottles, *E* intubated the deprived rats with a polyethylene tube (PE50) and injected 20 ml of tap water directly into the stomach. This intubation procedure and injection of 20 ml of tap water was done at approximately 24-hour intervals on 10 successive occasions. About one-half hour after the tenth and final intubation and injection of the water into the stomachs of the deprived rats, water bottles were returned to the cages. The nondeprived rats were also removed from the cages during this same period and intubated. The polyethylene tube remained *in situ* for 10 consecutive seconds without water injection at which time the tube was removed. The intubation of these nondeprived animals was also performed for 10 successive intubations at approximately 24-hour intervals.

All animals were given *ad lib* water for a week after the period of intubation. Hypertonic saline was injected and the responses to it recorded as above in the first experiment.

Three animals died as a result of the intubation procedure. In all cases this appeared to be a result of accidentally introducing the tube into the lungs. Two of the animals that died were in the deprived group, while the other animal was from the nondeprived group.

2. *Results*

The data from the second experiment were analyzed simply to ascertain whether there was an effect of deprivation without specific experience in drinking. The expectation was that if there were a difference it would favor the deprived animals so that they would show a reduction in response latency and an increase in three-hour ingested water volume.

The geometric means of the response latency for the intubated deprived and intubated nondeprived groups were 345 and 413 seconds, respectively. Statistical analysis of the difference between logarithms of the response latency gave an insignificant result ($F = 1.00$, $df = 1/13$). The mean three-hour volume of the deprived intubated animals was 19.9 ml, while the mean three-hour intake of the intubated control group was 15.6 ml. The relatively large mean of the former group reflects the occurrence of very large intake upon the part of the two rats (30.3 and 26.0 ml). Analysis of these data resulted in an insignificant difference between the means ($F = 2.57$, $df = 1/13$) despite the water ingestion of the two rats noted above.

D. DISCUSSION

The two experiments in the present paper demonstrate that the procedure usually used to adapt rats to a drinking schedule results in a reduction of response latency to drink following a hypertonic saline load when the animals have been returned to water balance. Moreover, there may be an increase in water ingestion, as well, under these circumstances. Drinking from a spout under these conditions, though not necessarily under the specific conditions of later test, is essential for the reduction in response or increase of intake volume to occur. Water deprivation alone is not a sufficient condition, although necessary.

One facet of the results that needs comment is the finding that three-hour ingested volume was greater for the previously deprived animals than for the animals with no history of deprivation. These data are not consistent with the notion that volume of water ingested is in a fixed relationship to the magnitude of the inducing stimulus whether that be water deprivation or a hypertonic solution. Apparently these data are contrary to the findings of Beck (1) and Wayner and Reimanis (7), who found that magnitude of water ingestion varied as a function of state of adaptation to a drinking schedule or amount of salt ingested, without regard to previous history of treatment. However, the present observation is consistent with most, though not all, previous data on ingested volume collected in this laboratory with the procedure described in this paper. At present, it would be somewhat rash to state that saline-induced drinking following adaptation to a water deprivation schedule is increased. Further evidence would seem desirable in light of Beck's (1) data.

The findings of the present study are not confirmatory of Beck's (1) finding of no learning during adaptation to a drinking schedule. However, the universe of discourse of this study is not adaptation *per se* as in Beck's study; nor have the conclusions been based upon ingested volume as in that study. Schmidt (5) has attempted to differentiate the significance of variations in drinking latency as compared with amount drunk. Our findings indicate that if there is a decrease in drinking latency, there usually is an increase in volume ingested, but not conversely (6).

The deprivation procedure described in this paper is not the only way in which drinking latencies can be reduced following a specified load of hypertonic saline. Phenobarbital injection in suitable quantities will do as well (6). Some unpublished data collected in this laboratory demonstrate a summation of the phenobarbital and learning effects described in this paper upon response latency after induction of drinking by hypertonic saline. These learning data taken together with the phenobarbital findings demonstrate an unexpected equivalence.

Perhaps the most evident explanation for the reduced response latencies reported here is that the rats learn to find the drinking spout during exposure to it. The data within the confines of the experiments reported could be so interpreted. But the phenobarbital findings reported elsewhere are not readily amenable to such speculation and the finding of summation of phenobarbital and effects of previous adaptation to the drinking schedule also does not appear fitted to such explanation. Equally possible is a reduction of the detection threshold for the drinking stimulus as a result of prior history, phenobarbital, or a summated combination of the two. An implausibility that would be introduced by this concept would be some dissociation between the mechanisms initiating drinking and those maintaining it to satiety if there is no significant increase in ingested water volume.

Irrespective of the particular change underlying the learned decrease in drinking latency, one is confronted with the problem of explaining why such a change takes place after prolonged drinking experience in the home cage. On the assumption that weaning takes place on or before Day 25, the rats in these experiments drank several times a day from tubes prior to the start of the study. Despite this, there is still further room for improvement. Two possible explanations present themselves. First, there is some learning of the kind described in this paper in the home cage and it is proportional to the extent of deprivation. A second alternative is that the stimuli evoking drinking when water is available *ad lib* are not the same as those eliciting drinking in a water deprived animal, and there is no transfer between the two states with respect to reduction of response latency. Moreover, there would be no learning in the *ad lib* situation.

E. SUMMARY

Two groups of rats were adapted to a water deprivation schedule for 10 days while a control was maintained on *ad lib* water. After a return to essential water balance, injection of hypertonic saline resulted in a reduction of the time to initiate drinking and an increase in volume of water ingested. Water deprivation of animals without drinking does not result in any change of response latency nor volume ingested. These findings indicate a learned change in drinking behavior, which may reflect an alteration of drinking threshold.

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THE EFFECTS OF TEMPORAL VARIABILITY ON THE REINFORCING PROPERTIES OF VISUAL STIMULUS CHANGE*

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A. INTRODUCTION

Previous research (1, 5) has shown that response-contingent visual stimulation that involves stimulus change produces higher rates of barpressing than does response-contingent visual stimulation alone. As used here, *stimulus change* refers to a situation in which the stimulus consequences of the *n*th response are discriminably different from those of the *n*th — 1 response. Operationally, stimulus change conditions have been instituted in earlier work by having each response produce light onset from one of two light positions in alternating fashion within a standard operant chamber. In the control condition, in which stimulus change does not occur, each response produced light onset from a single, invariant light position.

The present study grew out of an attempt to conduct a parametric study of the stimulus change dimension by arranging for each response to produce a train of photic pulses from up to four stimulus locations rather than a single pulse from one of two locations, as in previous work. Also, in contrast to the earlier procedure, each response initiated a visual display for a constant duration rather than for a duration that was coextensive with the duration of the response. As an evaluation of this method, a control group of seven hooded rats was given one second of response-contingent light from a single stimulus position (SP group); and a stimulus change group of seven animals was given one second of light from one of two alternating stimulus positions (AP group). Unlike previous findings, the AP group did *not* make more responses than the SP control group (65.1 and 92.1 responses per session for the AP and SP groups respectively; $t = -1.48$, $df = 12$, $p > .05$).

The foregoing preliminary experiment differed from previous work with

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stimulus change in two respects: (*a*) the duration of the stimulus was constant and (*b*) the offset of the stimulus was, therefore, not coincident with the termination of the barpressing response. The purpose of the present study was to determine which of these variables—the variability of stimulus duration or the degree of response control of stimulus offset—is a necessary condition for the previously reported reinforcing effects of stimulus change.

B. METHOD

1. *Subjects*

Forty-eight male, Long-Evans strain, hooded rats (Harlan Industries), 120 days old served as *S*s. All animals were reared under a normal light-dark cycle by the supplier, and were maintained on an artificial 14-hour-light and 10-hour-dark cycle in the laboratory for at least 15 days prior to the beginning of the experiment. Throughout the study, *S*s had continuous access to food and water.

2. *Apparatus*

During the experimental period, *S*s were kept in two types of enclosures—a standard operant test chamber or a light-tight isolation box. The dimensions and construction of both enclosures were identical to those described in an earlier report (1) with the sole exception of the replacement of the plastic walls and top with sheet aluminum and of the grid floors with 1/2-inch hardware cloth. Briefly, one wall of each test chamber contained four white pilot lamps (17.2 mL at the source) arranged in a rectangular pattern and symmetrically located about a response bar. When not in the test chambers, the *S*s were housed in living cages inside the isolation boxes. The test and isolation enclosures were sound-attenuating and were ventilated by blowers which also provided a masking noise. Eight enclosures of both types were used, with each being represented equally often in the various treatment conditions. The programming of the stimulus displays and the recording of responses was accomplished by equipment located in an adjacent room.

3. *Procedure*

In order to assess the contribution of the variability of stimulus duration to the AP-SP stimulus change effect unconfounded by the coincidence of stimulus offset and response termination, it was necessary to obtain the frequency distribution of barpress durations under conditions in which stimulus offset and response termination were coincident. This was accomplished by replicating previous work with SP and AP groups in which visual stimulation occurred for the duration of the response (Duration-Dependent Condition). Twelve *S*s served in each group, with the four single light positions assigned to three *S*s in the SP group and the six combinations of two light positions assigned to two *S*s in the AP group. The response durations were monitored by an Esterline-Angus operations recorder. The duration of each pen deflection was measured and then classified into .5-second intervals to determine the frequency distribution of response durations.

With knowledge of the frequency distribution of response durations available, conditions were arranged whereby each barpress for the remaining 24 *S*s produced light onset of an appropriately variable stimulus duration whose offset was independent of response termination (Duration-Independent Condition). This was accomplished through a punched paper tape system in which the relative frequency of occurrence of stimulus durations was the same as that obtained under the Duration-Dependent Condition. Twelve *S*s served in the SP group and 12 *S*s in the AP group under the same assignment of light positions as in the Duration-Dependent Condition.

The daily testing procedure for all groups consisted of seven hours in the isolation box followed by 17 hours in the test chamber (17:00 to 10:00). *S*s were transferred between enclosures with only the light provided by a red darkroom bulb. All *S*s were given one operant session in which barpressing was not reinforced by light onset followed by six conditioning sessions in which barpressing was reinforced.

C. RESULTS

In all of the following analyses, data are reported only from those *S*s whose response frequency on the six conditioning days significantly differed by *t* test from the operant level. Unlike previous work with test chambers of less homogeneity of construction, a substantial number of *S*s failed to condition by this criterion. The number of *S*s meeting this criterion were seven and seven in the SP and AP groups of the Duration-Dependent Condition and seven and six in the SP and AP groups of the Duration-Independent Condition.

Figure 1 depicts the relative frequency distributions of response durations obtained during the operant session and the conditioning sessions of the Duration-Dependent Condition. The relative frequency distribution was determined for each animal separately and averaged to produce the data points. No differences in response duration were found between the SP and AP groups or between sessions. The smooth curve represents the exponential trend line fitted to the conditioning data ($r = -.988$). As shown in Figure 1, most reinforced

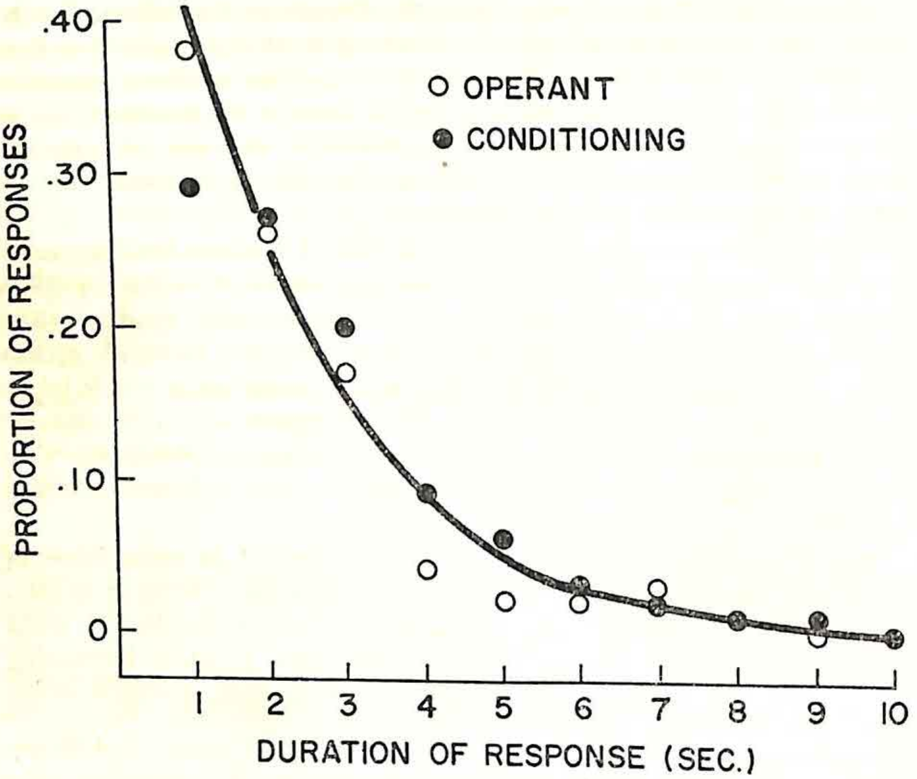

FIGURE 1
THE RELATIVE FREQUENCY OF OCCURRENCE OF RESPONSE DURATIONS DURING OPERANT AND CONDITIONING SESSIONS
Where identical frequencies were obtained, only the data for the conditioning sessions have been indicated.

responses were of short duration with only 2 per cent being greater than 10 seconds.

The dependent variable used to assess the contribution of the variability of stimulus duration to the stimulus change effect was the number of barpressing responses per session. Prior to comparing the behavior in conditioning sessions, it was first established that there were no differences among the four treatment groups in operant level ($F = 1.89$; 3, 23 *df*; $p > .05$). In the first conditioning session, all groups increased their frequency of barpressing. For the Duration-Dependent Condition, the significance test for the SP group was $t = 2.44$, 6 *df*, $p < .05$ and for the AP group was $t = 4.48$, 5 *df*, $p < .01$. For the Duration-Independent Condition, the comparable tests were $t = 2.33$, 6 *df*, $p < .05$ for the SP group and $t = 3.75$, 6 *df*, $p < .01$ for the AP group. The mean number of responses per session for the four treatment groups is shown in Table 1. In confirmation of previous research, more responses were made in the AP stimulus change groups than the SP groups; $t = 1.81$, 23 *df*, $p < .05$. No differences were produced by the mode of control of stimulus duration (Duration-Dependent *vs.* Duration-Independent) nor did this variable interact with conditioning sessions. Thus, with a variable stimulus duration, stimulus change produced an increment in responding unaffected by whether the termination of the response was coincident with the offset of the stimulus.

TABLE 1
MEAN NUMBER OF REINFORCED RESPONSES PER SESSION
(Mode of control of stimulus duration)

Dependent on R duration		Independent of R duration	
SP	AP	SP	AP
42.9	66.4	49.7	67.1

Note: SP = single stimulus positions group; AP = alternating stimulus positions group.

D. DISCUSSION

The results of the present study indicate that the SP-AP stimulus change effect is present only if the stimulus duration is variable. The origin of the variability—whether programmed internally by the organism through the coincidence of stimulus offset and response termination (Duration-Dependent Condition) or programmed externally through control circuitry (Duration-Independent Condition)—is of no apparent consequence. The identification of stimulus variability as a factor in the stimulus change effect resolves a previously existing inconsistency in the literature. Morris, Crowder, and Crowder (4) had reported that the AP condition did not elevate response frequency. These investigators, in addition to using a relatively insensitive test procedure (1), did not employ a variable stimulus duration, which the present experiment has shown is a prerequisite to the stimulus change effect.

Other investigations by Fox (2) and Jones, Wilkinson, and Braden (3) have shown that temporal variability of stimulus onset potentiates the reinforcing effects of visual stimulation. In Fox's research using monkey *S*s, bar-pressing rates and evoked potential amplitudes indicated a preference for trains of photic pulses which were characterized by uncertainty in the distribution of interpulse intervals. The present study extends this finding and indicates that uncertainty in the distribution of pulse durations potentiates the stimulus change effect whether the origin of the uncertainty is response-dependent or response-independent.

Finally, with the more homogeneous test chambers used in the present experiment, the frequency of responding was reduced to approximately one-half the value obtained in earlier work (1, 5). Since, in all other respects, the Duration-Dependent Condition was a replication of previous experiments, the reduction in responding can be ascribed to the decreased complexity of test chamber stimuli available to the animal with each visual stimulus presentation.

E. Summary

Contrary to previous research in which response-contingent light onset with stimulus change produced higher rates of barpressing than response-contingent light onset alone, an experiment using constant light durations failed to confirm the stimulus change effect. In order to determine whether the necessary condition for stimulus change reinforcement is variable stimulus duration or the coincidence of stimulus offset with response termination, two conditions were instituted both having identically variable stimulus durations. For one group, the stimulus occurred for the duration of the response; for the other group, the stimulus terminated independent of the duration of the response. The results indicated that, in both groups, stimulus change produced higher response rates than did response-contingent light onset alone. A variable stimulus duration is, therefore, a necessary condition for the presence of the stimulus change effect. This finding was related to other investigations that have documented the role of temporal variability in sensory reinforcement.

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SIX- AND TEN-YEAR-OLDS' ATTRIBUTION OF PUNITIVENESS AND NURTURANCE TO PARENTS AND OTHER ADULTS*

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A. INTRODUCTION

Children's perceptions of parents have been widely studied, but no studies have been directed toward comparing children's perceptions of parents to their perceptions of adults outside the family. Such a comparison is the purpose of the present paper.

The findings with respect to children's perceptions of parents are consistent with respect to the attributes assigned to mothers and fathers. Mothers are viewed as more affectionally nurturant than are fathers, and fathers are viewed as more capable of instrumentally nurturant, aggressive, and more dominant or powerful behavior than are mothers (3, 5, 6, 7, 8, 10, 11). Sex differences are generally found in these attributes and they comprise, as well, masculinity and femininity, the content of sex roles in our society (9).

The view that the child's early relations with his parents are prototypic of, or highly influential in determining, his later social relations is commonly encountered. According to psychoanalytic theory, the early "family romance" shapes the child's later perceptions of other persons. Social learning theory would predict similarities in the child's perceptions of parents and other adults on the basis of generalization from parent to stranger. The demonstration of similarities in the child's perceptions of parents and his perception of others is consonant with the hypothesis that such a process as generalization is involved but not proof of it. The child's experiences with other adults and with portrayals of adults in the mass media might contribute, as well, to similarities of perception, particularly insofar as parents and other adults share common sex-role attributes. A somewhat more conclusive test of the generalization hypothesis is possible in those cases where the child's perceptions of parents are not in accord with commonly held sex-role expectations (1). In these cases,

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[1] The authors are indebted to Philip Pettman for his assistance in analyzing the data for this study.

similar perceptions of other adults cannot be explained by recourse to exposures to other adults or to the mass media.

The following hypotheses regarding perception of parents and adults in general were tested in the present study:

1. Children perceive fathers as more punitive and instrumentally nurturant than mothers and mothers as more affectionally nurturant than fathers.
2. Children perceive men in general as more punitive and instrumentally nurturant than women and women as more affectionally nurturant than men.
3. Children attribute the same characteristics to adults of the same sex as the parent to whom they attribute the characteristics (e.g., if a child sees the mother as the more punitive parent, he also sees women in general as more punitive than men). This relationship should be independent of the sex-role appropriateness of the characteristic.

B. Method

1. *Subjects*

There were 96 *S*s interviewed for this study (25 six-year-old boys, 22 six-year-old girls, 22 10-year-old boys and 27 10-year-old girls). The selection procedure originally called for 25 *S*s in each age-sex group; however, the method used for obtaining subjects led to uneven *N*s for each group. *S*s were selected from two middle-class suburban areas and from a middle-class residential area of a nonmetropolitan small city. Of the 111 parents contacted (through the use of a combination of city and telephone directories), 13.5 per cent refused the participation of their children; so that the final *N* was 96, with the uneven age-sex distribution.

2. *Procedure*

Children's perceptions of parents and other adults were assessed by means of a questionnaire especially developed for this purpose. The items used were selected from a larger pool employed in a pilot study on the basis of significant intrascale correlations. There were six scales, one inquiring about parents and another inquiring about other adults for each of three characteristics: punitiveness, affectional nurturance, and instrumental nurturance. Each scale is comprised of three items, with the exception of the Instrumental Nurturance Scale-Parents which has five items. All questions require that the child make a forced choice between "mom" and "dad" or "woman" and "man." Sample items include the following: Affectional Nurturance, "Who kisses you most?"; Instrumental Nurturance, "A child can't open a very heavy door and someone is opening the door for him when his mom or dad are not around. Who is opening the door: is it a woman or a man?"; Punitiveness, "When your mom and dad are home, who yells at you most?" All items in the scales dealing with other adults specify that parents are not present in the situation, as in the instrumental nurturance example above.

Each child was interviewed individually in a quiet place (his room, backyard, the living room) by one of the investigators. No other adults or children were present while the interview took place. *E* read each question from the questionnaire, asking the questions dealing with perceptions of other adults before the parent-oriented questions. The children were assured of the confidentiality of their responses and asked to make a choice on every item even if one parent or other adult "did it just a little bit more than the other."

For the purpose of data analysis, *S*s were classified as perceiving the father as more punitive if he was the parent chosen on two or three of the three punitiveness items; men as more instrumentally nurturant if they were chosen on three, four, or five of the five instrumental nurturance items; and so on. In each case, the classification was based upon a majority of choices for one parent or same-sexed social agent. Agreement in attribution of a particular characteristic was considered to be present when the sex of the child's choices on the Other Adult Scales corresponded with the sex of the parent chosen on the Parental Scales.

C. RESULTS AND DISCUSSION

Table 1 presents the proportions of *S*s answering "mother" to the questions dealing with parental punitiveness, instrumental nurturance, and affectional nurturance. The proportion answering "father" is, of course, obtainable by subtracting the proportions in Table 1 from unity. At both six and 10 years, for both boys and girls, all of the proportions are significantly different from .5 (the expected chance value) at beyond the 1 per cent level and all are in the expected direction. Both boys and girls at both age levels view fathers as more punitive and instrumentally nurturant than mothers and mothers as more affectionally nurturant than fathers. Hypothesis 1 is thus confirmed with respect to all three characteristics.

Table 2 shows the results for these three characteristics when the social agents in question are adults other than parents. Once again, for all three characteristics, for both age groups and for both sexes, the differences between *S*s answering "woman" and "man" are all in the expected direction; and all proportions exceed the 1 per cent level of significance. Women are viewed as more affectionally nurturant than men, and men are seen as more punitive

TABLE 1
SIGNIFICANCE OF PROPORTIONS OF *S*s ATTRIBUTING PUNITIVENESS AND NURTURANCE TO MOTHERS

	Per cent replying "Mother"			
	Boys		Girls	
Characteristic	6-yr.-olds ($N = 25$)	10-yr.-olds ($N = 22$)	6-yr.-olds ($N = 22$)	10-yr.-olds ($N = 47$)
Punitiveness	20****	27**	9****	33*
Instrumental Nurturance	8****	9****	23***	18****
Affectional Nurturance	80****	91****	68*	80****

Note: All tests are for significance of differences between the obtained proportion responding "Mother" and .5 (the expected value) where the forced choice alternatives are "Mother" and "Father."
* = $p < .05$ (lt).
** = $p < .01$ (lt).
*** = $p < .005$ (lt).
**** = $p < .001$ (lt).

and instrumentally nurturant than are women. Hypothesis 2 is also confirmed with respect to all three characteristics.

Children of both six and 10 thus make sex-appropriate attributions of characteristics to both parents and nonparental social agents. There are no general indications of increasingly sex-appropriate attribution with age from six to 10. Sex-appropriateness is already so strong at six that, given the present sample size, the small increases that are possible would not reach statistical significance. In point of fact, the only scale difference to reach significance involved girls' perceptions of parental punitiveness, with more girls of six than girls of 10 viewing the father as punitive ($t = 2.44$; $p < .02$). This scale

TABLE 2
SIGNIFICANCE OF PROPORTIONS OF *S*s ATTRIBUTING PUNITIVENESS AND NURTURANCE TO ADULT WOMEN

	Per cent replying "Woman"			
	Boys		Girls	
Characteristic	6-yr.-olds ($N = 25$)	10-yr.-olds ($N = 22$)	6-yr.-olds ($N = 22$)	10-yr.-olds ($N = 47$)
Punitiveness	36****	18**	18****	22*
Instrumental Nurturance	12****	9****	14***	18****
Affectional Nurturance	88****	100****	82*	96****

Note: All tests are for significance of differences between the obtained proportion responding "Woman" and .5 (the expected value) where the forced choice alternatives are "Woman" and "Man."
* = $p < .05$ (lt).
** = $p < .01$ (lt).
*** = $p < .005$ (lt).
**** = $p < .001$ (lt).

difference is attributable to significant differences between the two age groups in two of the items making up the Punitiveness Scale (father yells more than mother, $p < .05$; father spanks more than mother, $p < .10$).

Bronfenbrenner (1) has argued that the girl is more responsive than the boy to socialization (disciplinary and control) techniques because of greater parental display of affection toward her and her consequent greater attachment than the boy to parents. Perhaps the father, while remaining the punitive parent, *is* less punitive at age 10 than he was when the child was six. Kohn and Carroll (12) have suggested, as well, that a parental division of labor is developing in the middle class in such a way that parents are assuming "responsibility" for children of the same sex as themselves. It may be that as the girl grows older, the father plays a lesser role in disciplining her (relative to the mother) and is, in fact, less punitive toward her at 10 than he was at six. On the side of the girls' perception rather than parental reality, psychoanalytic theory would predict more sensitivity to threats of loss of paternal love at six than later when the girl is 10 and past the Oedipal period (4).

There were no significant sex differences in perceptions of parents or other social agents. More six-year-old boys than girls saw the father as being instrumentally nurturant, but the difference reached only the 10 per cent level of significance ($t = 1.95$). Item analysis suggests that this difference is largely attributable to the boys' more often viewing the father as able "to show them how to do things" ($p < .05$). The trend observed might well reflect differential identification-imitation patterns for boys and girls. Presumably a model of the same sex can show the child how to do (at least, more sex-appropriate) things.

Hypothesis 3 is that, independent of the sex appropriateness of the attribution of characteristics to parents and other adults, *S*s who attribute a particular characteristic to a parent also attribute that characteristic to other adults of the same sex. Table 3 shows that, with two exceptions, such agreements in same-sex attribution are characteristic of both boys and girls at both age levels. Percentages of agreement failed to reach significance for 10-year-old boys and girls on the punitiveness variable. The trend toward agreement was more nearly significant for boys ($p < .08$) than for girls ($p < .18$). Eleven of the 27 girls showed disagreement. Nine of these 11 girls made "inappropriate" attributions of punitiveness to the mother. Thus 82 per cent of the disagreements are cases where ("inappropriate") perceptions of the mother as punitive accompany ("appropriate") perception of adult male agents as punitive. Whatever the reason for the higher incidence of 10-year-old girls' perceptions of mothers as punitive, social agents (hypothetical) other than parents continue to be viewed in a stereotyped manner. Consequently, the data on punitiveness (particularly for girls) are not consonant with a generalization hypothesis. The investigators have not found a satisfactory explanation of these data which also explains the absence of similar differences on the nurturance dimensions.

TABLE 3
SIGNIFICANCE OF PROPORTIONS OF *S*s WHO AGREE IN ATTRIBUTION OF PUNITIVENESS AND NURTURANCE TO SAME-SEXED PARENTS AND ADULTS

	Per cent who agree in attribution to same-sexed parents and adults			
	Boys		Girls	
Characteristic	6-yr.-olds ($N = 25$)	10-yr.-olds ($N = 22$)	6-yr.-olds ($N = 22$)	10-yr.-olds ($N = 47$)
Punitiveness	76***	64	82****	59
Instrumental Nurturance	96****	86****	77***	70*
Affectional Nurturance	68*	91****	73**	72*

Note: All tests are for significance of differences between the obtained proportions of *S*s who agree in attributing the characteristic involved to same-sexed parents and adults and the proportion expected to agree on the basis of chance alone (.5).

* = $p < .05$ (lt).
** = $p < .01$ (lt).
*** = $p < .005$ (lt).
**** = $p < .001$ (lt).

Both sex and age differences in attribution agreement involved the same scale, Affectional Nurturance. Ten-year-old boys had higher agreement scores than six-year-old boys and 10-year-old girls. These differences apparently reflect the fact that 10-year-old boys nearly always attributed affectional nurturance to mothers (91 per cent) and always assigned it to women rather than men (100 per cent). As may be seen in Tables 1 and 2, the comparable percentages for six-year-old boys and 10-year-old girls are somewhat lower. In cases where sex-appropriate attribution is so nearly universal, high proportions of agreement are the only possible outcome.

In fact, the very high consensus in the attribution of characteristics to the "appropriate" parent (Tables 1 and 2) precluded testing for the significance of agreement on non-sex-appropriate perceptions. As may be seen in Table 4, the number of non-sex-appropriate respondents is very low in every age-sex group. While the low N prevents tests of significance, inspection of Table 4 reveals that in almost every group disagreements are more common than are agreements. That is, children of both sexes and ages who assign nonappropriately sex-typed characteristics to parents apparently tend to assign appropriately sex-typed characteristics to other adults. To the extent that agreements occur, they tend to be more characteristic of six than 10-year-olds and perhaps more often found in the attribution of punitiveness than nurturance.

TABLE 4
FREQUENCY AND PROPORTIONS OF *S*s WHO AGREE IN ATTRIBUTION OF NON-SEX-ROLE-APPROPRIATE CHARACTERISTICS TO SAME-SEXED PARENTS AND ADULTS

	Frequency and per cent agreement in attribution to same-sexed parents and adults			
	Boys		Girls	
Characteristic	6-yr.-olds	10-yr.-olds	6-yr.-olds	10-yr.-olds
Punitiveness	4/7 (57%)	1/7 (14%)	1/3 (33%)	2/11 (18%)
Instrumental Nurturance	2/2 (100%)	0/2 (0%)	1/6 (17%)	0/5 (0%)
Affectional Nurturance	0/5 (0%)	0/2 (0%)	1/7 (14%)	0/6 (0%)

As noted above, consideration of agreement on inappropriate attributions was expected to serve as a more stringent test of the argument that perceptions of adult roles are based upon generalization from parents to other social agents. While the authors were not able to carry out such a test due to the low *N*s, the predominance of disagreements for both six- and 10-year-olds is discouraging to the hypothesis. Presumably, children's perceptions of parents become more realistic with age (2). In some cases, therefore, one would expect the mother to be chosen as the more punitive agent, the father as the more affectionally nurturant. When *S*s are confronted with questions about hypothetical adults at ages six and 10, the best guesses are those that are in accord with the cultural stereotype. It follows, then, that disagreement might well be more characteristic of 10-year-olds than six-year-olds. This argument is limited, of course, to the fairly small number of 10-year-old *S*s who make "inappropriate" but perhaps realistic attributions (see Table 4). It suggests, however, the more general hypothesis that discriminations between parents and other social agents should be more characteristic of 10-year-olds than six-year-olds.

The findings as a whole suggest that attempts to test for generalization by assessment of agreements in attribution of sex-inappropriate characteristics need to employ considerably younger *S*s. They might, as well, make use of characteristics that are relatively neutral with respect to sex-typing. In this way, agreement indices could with greater confidence be accepted as indicative of generalization, since at least some other alternative (third source) explanations could be eliminated.

D. SUMMARY

Ninety-six children (25 six-year-old boys, 22 six-year-old girls, 22 ten-year-old boys and 27 ten-year-old girls) were administered a forced-choice questionnaire dealing with their perceptions of mothers, fathers, and men and women in general. It was predicted and confirmed that both boys and girls

would perceive males (whether fathers or strange adults) as more punitive and instrumentally nurturant than females (whether mothers or strange adults) and females as more affectionally nurturant than males. The perceptions were nearly universal for both boys and girls by age six. Few sex differences and increases with age in sex-appropriateness of attribution were found. As hypothesized, those children who attributed a characteristic (sex-appropriate or not) to fathers also attributed that characteristic to male adults; those who attributed the characteristic to mothers also attributed it to female adults. These findings were discussed with reference to generalization of perception from parents to other adults. A separate analysis of agreement in attribution of sex-inappropriate characteristics suggested the possibility that agreement in attribution (and, by implication, the effect of generalization) is stronger at age six than at 10.

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EFFECTS OF PREVIOUS RADIATION EXPOSURE ON THE ACTIVITY RESPONSE TO D-AMPHETAMINE HYDROCHLORIDE*[1]

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A. Problem

McDowell (2) has suggested that radiation effects are in part, at least, like mild sedation effects. This suggestion was based on the fact that whole-body exposure to radiation appears to facilitate delayed-response performance of monkeys (1, 3) in a manner similar to the facilitation of delayed-response performance shown by the prefrontal monkey given Dial or Nembutal (4).

If whole-body exposure to radiation renders the animal chronically "sedated," then a standard amount of a known central nervous system stimulant should not activate the irradiated *S* to the same absolute level that it activates the normal *S*. The present study provided a direct test of this hypothesis. Its main objective was to determine if intramuscular injection of D-amphetamine hydrochloride produces the same pattern and level of increase in motor activity of the previously irradiated rat as it produces in the control rat.

B. Materials and Methods

1. *Subjects*

Eight control and eight whole-body irradiated male Sprague-Dawley rats served as *S*s. The irradiated *S*s had received 500 R in 50 seconds of whole-body exposure to gamma radiation when they were four months old. The present study was initiated 100 days after exposure.

Four control and four irradiated *S*s were assigned to drug groups. Similarly, four control and four irradiated *S*s were assigned to placebo groups.

2. *Procedure*

Prior to initiation of the study each *S* was given a 24-hour adaptation period in the standard activity wheel. Then, one *S* of each group was tested each day over a four-day period in order to permit counterbalancing the order of drug administration.

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Each *S* of the two drug groups was given 3 mgm per pound of body weight of D-amphetamine hydrochloride injected intramuscularly. Each *S* of the two placebo groups received an equivalent volume of distilled water injected intramuscularly. Each *S*, after being injected, was placed in the standard activity wheel and tested for one hour, with readings being recorded every 10 minutes.

C. RESULTS

Figure 1 shows the mean cycles during successive 10-minute periods following injection for each of the four groups. Statistical evaluation of the data upon which Figure 1 is based, by means of an analysis of variance procedure, yielded a treatment effect that was beyond the .01 significance level, a radiation effect that was beyond the .05 significance level, and a treatments by irradiation effect that was beyond the .05 significance level. It also yielded a time effect that was beyond the .01 significance level and a treatments by time interaction that was beyond the .01 significance level. It failed to yield a significant treatments by irradiation by time interaction.

The significant treatments by irradiation effect reflects the fact that the *S*s of the control drug group had more cycles beyond the .05 significance level than did the irradiated drug *S*s, while the placebo control *S*s failed to differ

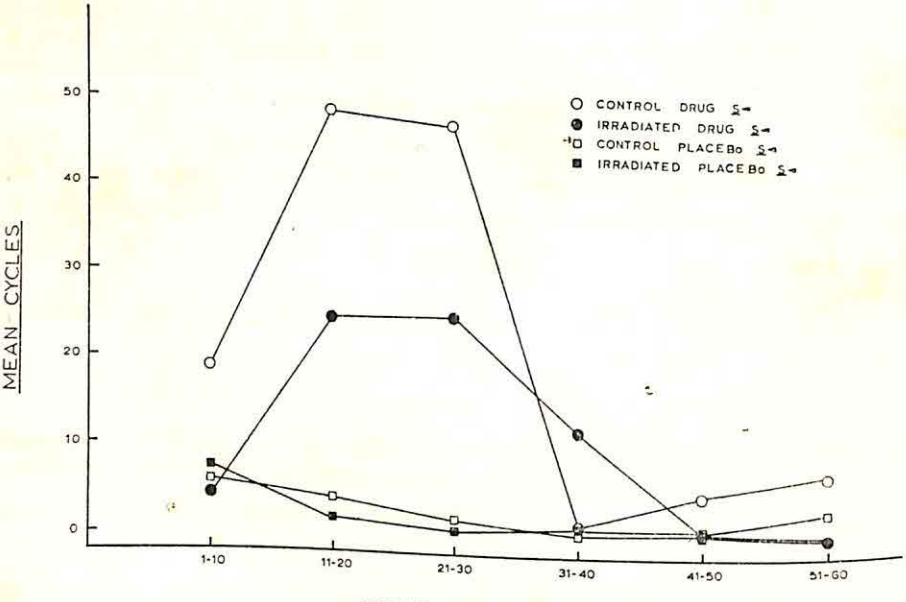

FIGURE 1
MEAN CYCLES DURING SUCCESSIVE 10-MINUTE PERIODS AFTER INJECTION FOR EACH OF THE FOUR GROUPS

significantly from the placebo irradiated *S*s. The failure to obtain a significant treatments by irradiation by time interaction indicates that the pattern of effect within treatment groups failed to differ.

D. Discussion

The results of the present study support the hypothesis that whole-body exposure to radiation renders the animal chronically "sedated." Rats previously exposed to whole-body radiation show a lesser response (but the same pattern) to D-amphetamine hydrochloride than do control rats. The results argue for a persisting effect of whole-body radiation on the central nervous system.

It could be argued that the effects noted were due to radiation induced changes in the total physiological response to amphetamine: i.e., a completely altered pathway. However, the response pattern indicates the possibility that the physiological response pathway was unaltered, since the response profiles of the controls and the irradiated *S*s were virtually the same, differing only in magnitude. These findings suggest a radiation induced increase in threshold of stimulation that mimics the action of sedating drugs.

E. Summary

The activity response of control and previously irradiated rats to D-amphetamine hydrochloride was studied with the use of the appropriate placebo controls. The irradiated rats had been given whole-body exposure to 500 R of gamma radiation 100 days earlier. The results showed that previous exposure to radiation lowers the level of response to the drug, but fails to alter the pattern of response.

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DIMENSIONS OF PARENTAL PRACTICE CONCERNED WITH COGNITIVE DEVELOPMENT IN THE PRESCHOOL CHILD*[1]

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A. INTRODUCTION

Research dealing with parental practices that shape patterns of development in childhood has focused primarily upon those aspects of child-rearing that are logically related to personality development and social adjustment (2, 14, 19, 26). Until fairly recently, only passing consideration has been given to the effects of rearing practices upon cognitive and intellectual achievement. However, considerable evidence is now available to indicate that modes of parent-child interaction during the early years can be critical to the level and quality of cognitive skills that the child ultimately develops.

As a result of recent studies there is reason to believe that patterns of verbal communication between parent and child, and the way in which language is utilized, affect not only the child's verbal development but also the ability to utilize higher-order concepts in problem solving (4, 5, 11, 13). Further evidence from research dealing with parental pressures for intellectual achievement has shown the effects of these pressures upon the achievement needs of the child and the type of achievement behaviors that he displays (7, 8). Still other aspects of the home environment, including "social climate" and physical facilities, have been found to be associated with the child's academic and intellectual performance, as have parental personality characteristics and the mother's teaching "style" (1, 10, 21). All of these factors of parental behavior and social environment would appear to have some link to the formation of conceptual processes in the child and the way in which he perceives and organizes his environment—customarily characterized as "cognitive style" (17, 28).

Many of the studies that deal with conditions antecedent to the child's cognitive development are highly dependent upon retrospective reports of the parent (primarily the mother) regarding practices utilized some years earlier.

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In other instances, the data are obtained largely from observation of parent-child behavior in a laboratory setting. The former procedure has been subject to criticism in terms of the validity and reliability of parental report, and the latter in terms of the artificial nature of the experimental setting when contrasted with parental behavior in the home (3, 9, 20, 22, 29). In either event, there is limited knowledge of those ongoing (contemporaneous) rearing practices in the home that might influence cognitive growth in the young child and the way parents view this aspect of the child's development.

The intent of the present study was to construct an appropriate questionnaire for assessing those parental practices for which prior research had indicated reasonable validity in their influence upon the child's cognitive development. As part of the analysis it was also intended that underlying dimensions of this area of child-rearing practice be identified for use in further item and questionnaire development, as well as to determine the relationship of these dimensions to various family (demographic) characteristics.

B. METHOD

1. *Questionnaire*

A 60-item questionnaire consisting of two sections was developed. The first, and major, section contained 50 items arranged in a Likert-scale format with four choice points for each item along the scale from least to most applicable. The second section consisted of 10 items, five of which were open-ended and another five of the multiple-choice type. Items chosen were based almost entirely upon previous research evidence indicating some degree of relationship between a particular form of parent behavior and subsequent cognitive performance of the child. Six *a priori* categories that are mentioned extensively in the literature served as a guide for selecting a balanced set of items. These categories were parental aspirations for the child's education, verbal patterns of the home (i.e., "quality" of language), type of parental guidance provided, facilities available for the child's use, interaction with other children and adults, and parental use of reward or punishment to encourage learning. Item wording was based, where possible, upon applicability of *present* practices engaged in by the parent with their preschool child rather than upon opinion of what the rearing practices *should* be.

The second section of the questionnaire (multiple-choice and open-ended items) included questions on occupational goals desired for the child, toy and book purchases by the parents, and expectation of ages at which certain verbal skills should be displayed. Detailed instructions were attached to each questionnaire along with a sheet requesting data concerning family size, father's and mother's education, father's occupation, sibling rank of the child for whom the parent responses were intended, sex and age of the child, whether or not the mother worked outside the home, and the number of hours per week she spent working. The same questionnaire was used for mothers and fathers. Where there was more than one preschool child in the family, the parent was instructed to respond with reference to the eldest of the preschool children.

2. *Sample*

An essentially middle-class community of approximately 1500 private homes located in central New Jersey was chosen as the group from which a sample of 203 respondents was obtained (109 mothers and 94 fathers). Since there were no prior census data available regarding the ages of children in each household, blocks of homes were chosen as the sampling unit and were randomly sampled within the community. The 203 respondents were all parents of children between two and six years of age who had not yet entered grade school, and were all from separate households, so that there was no instance of a mother and father from the same family serving as respondents.

An interviewer visited every home in a selected block and gave the questionnaire to an eligible parent at the home, along with an explanation of the intent of the study. (The wife generally accepted the questionnaire which was intended for completion by the husband and returned it to the interviewer after it had been completed by him.) Completed questionnaires were collected at the respondents' homes a day or two later, and they were paid $2.50 for their cooperation.

C. RESULTS

The middle-class character of the community sampled is evident from the distribution of fathers' occupational and educational levels as presented in Table 1. Occupational level was rated on a seven-point scale derived from the one developed by Warner, Meeker and Eells (27) and is comparable to distribution for these measures found in other middle-class samples (16). Rating categories range from unskilled laborer ("1" on the scale) to high-level professional ("7"). Educational level was also distributed over a seven-point scale ranging from less than seven years of school (rating of "1") to attendance in postgraduate or professional school ("7"). It should be kept in mind that any results reported, and generalizations of these, should be considered applicable to children of preschool level and parental behavior of individuals of essentially middle-class status.

TABLE 1
PARENTAL OCCUPATIONAL AND EDUCATIONAL LEVEL

Scale value	Father's educational level	Father's occupational level	Mother's educational level
7	48	40	20
6	53	52	35
5	49	61	35
4	40	23	96
3	6	16	12
2	4	7	4
1	0	0	0
No data	3	4	1

1. *Scale Analysis*

Scores on the 50 scaled items were intercorrelated and the 50 × 50 matrix factor analyzed. A varimax rotation of a principal components solution (18) resulted in six meaningful orthogonal factors. Factor loadings for the items used in the interpretation of each factor are reported in Table 2 with the items identified by summary statements. (A factor loading .33 or greater was arbitrarily chosen for use in factor interpretation.) The designation and interpretation of the six factors are as follows:

Factor I: *Willingness to Devote Time to the Child*. This emerges as the clearest factor of the six and is readily interpretable as one that involves the degree to which a parent is willing to spend time with the child, primarily playing with him and talking to him. This response pattern is also characterized by the degree of willingness to pay attention to the child when he seeks attention, even to the extent that the parent interrupts his own tasks in order to do so. This attentiveness on the part of the parent cuts across numerous daily activities of the child and across a variety of parent-child interaction situations.

Factor II: *Parental Guidance*. The items that define this dimension are concerned with the degree to which the parent controls the amount and type of television viewing by the child, the frequency of purchase of toys that are intended to teach, the amount of time spent in reading to the child each day, and the degree to which the child is encouraged to be self-reliant. There would appear to be an element of parental control in these practices and an awareness of cognitive growth. This awareness is further amplified by significant loadings on items that deal with the amount of time spent playing word games with the child and the degree to which the parent checks the age-appropriateness of toys that are purchased. The factor seems to reflect the

TABLE 2
FACTOR LOADINGS

Item summary statement	I Willingness to devote time	II Parental guidance	III Aspiration for achievement	IV Rejection *vs.* acceptance	V Provision for child's needs	VI External resources
1. Amount of time spent daily playing with child	*.83*	.10	.03	.00	.03	.06
2. Time spent daily using child's toys and books in playing with him	*.76*	.19	—.06	.03	.12	.00
3. Time spent daily talking with child	*.66*	.25	.01	.12	.14	—.09
4. Take time to pay attention to things child shows you	*.39*	.03	—.14	*.33*	.13	—.26
5. Discuss child's education with spouse	*.37*	.11	.09	.00	.09	.25
6. Permit child to eat at table with family	*.37*	—.19	.04	—.01	.05	.14
7. Willingness to interrupt own tasks to play with child	*.36*	—.20	—.05	.14	.13	—.17
8. Willing to demonstrate something to child when playing with him	*.34*	.28	.23	.08	—.31	.10
9. Read to child each day	*.34*	*.52*	—.12	.23	*.36*	.18
10. Encourage child to play with older children	*.33*	.16	.27	—.19	—.17	—.08
11. Encourage viewing of certain T.V. programs	.14	*.69*	—.01	—.11	.13	—.15
12. Limit amount of T.V. viewing	.05	*.57*	—.06	.01	*.34*	—.06
13. Buy toys that teach	.17	*.47*	.26	—.10	.14	.23

TABLE 2 (*continued*)

Item summary statement	I Willingness to devote time	II Parental guidance	III Aspiration for achievement	IV Rejection *vs.* acceptance	V Provision for child's needs	VI External resources
14. Encourage child to entertain himself when parent not available	—.10	*.46*	.09	.01	.03	.25
15. Importance of toy purchases	.25	*.37*	.26	—.08	—.08	.03
16. Play word games (name objects)	.07	*.35*	.31	.28	—.05	.00
17. Check age recommendations before buying a toy	.07	*.33*	.16	.03	—.24	.06
18. Stress that the child do his best	—.07	.05	*.56*	—.05	.07	.11
19. Correct poor language usage	.04	.08	*.56*	.11	—.08	—.06
20. Encourage child to play with certain "desirable" children	.04	.15	*.48*	—.21	—.02	—.13
21. Expectation for grades in school	—.01	—.07	*.47*	.12	.06	—.01
22. Intention of sending child to college	.05	.08	*.44*	.08	.20	.03
23. Encourage child to excel in competitive tasks	.05	.02	*.41*	—.24	—.27	.12
24. Level of minimum education required for child	.08	—.03	*.36*	—.15	*.38*	.10
25. Compliment child when he does something new	.31	.12	*.36*	.28	.01	.08

TABLE 2 (*continued*)

Item summary statement	I Willingness to devote time	II Parental guidance	III Aspiration for achievement	IV Rejection *vs.* acceptance	V Provision for child's needs	VI External resources
26. Have child help in household chores	—.06	.26	*.35*	—.01	.02	—.09
27. Degree of effort expended in teaching child to talk	.12	.25	*.33*	.25	—.29	.24
28. Praise when child "performs"	.12	—.13	.02	*.62*	.03	.23
29. Something outstanding performed before child is praised	—.05	—.16	.03	*—.54*	.06	—.24
30. Insistence on playing with certain games and toys	.11	.30	.08	*—.51*	—.02	.11
31. Degree to which English is spoken in the home	—.07	.06	.05	*.47*	—.24	—.25
32. Refrain from punishment (by locking child in room)	.04	.14	—.01	*.46*	—.11	*—.36*
33. Mother cannot hold outside job and provide good training	—.03	—.08	.04	*—.39*	*—.39*	.03
34. Willingness to assist child to read before starting school	.20	—.16	.20	*.34*	.01	.19
35. Do not favor leaving child with baby sitter	—.05	.22	—.15	—.15	*—.54*	.04
36. Financial preparation for college	.21	.10	.20	—.09	*.46*	—.11
37. Separate play area provided in the home	—.14	.09	—.10	—.17	*.42*	.18

TABLE 2 (*continued*)

Item summary statement	I Willingness to devote time	II Parental guidance	III Aspiration for achievement	IV Rejection *vs.* acceptance	V Provision for child's needs	VI External resources
38. Take child to places of interest	.22	.03	.15	.00	*.41*	—.10
39. Take child to playground or other play areas outside of the home	.19	.04	—.01	.00	*.37*	.08
40. Provide library of children's books in home	—.05	.28	.10	—.12	*.35*	—.05
41. Send child to nursery school as early as possible	—.05	—.06	.05	.05	.17	*.62*
42. Can use advice on teaching the child	.06	.05	—.03	.12	—.12	*.50*
43. Use material rewards to get the child to learn	—.01	.07	—.24	—.03	—.10	*.42*
44. Encourage use of toys that develop language	.31	.28	.16	.06	.12	*.41*
45. Child's playtime should serve a teaching purpose	.21	.10	.26	—.06	—.15	*.40*
46. Buy toys and books for child	.15	—.16	.14	.20	—.15	.17
47. Value of special preschool programs of instruction	—.17	.21	.03	.07	.28	.26
48. Child listens to children's records	.05	.10	—.12	—.02	.22	.00
49. Time spent with older children or adults	.29	—.23	.30	—.08	—.01	—.01
50. Use "baby talk" with child	.07	.20	.11	.10	—.04	—.23

extent to which the parent structures the child's activities and the degree of willingness to play a role in the child's cognitive development.

Factor III: *Parental Aspiration for Achievement.* This particular factor resembles the widely postulated concept of parental aspiration for the child's achievement that is found in the literature (8). Based upon the factor loadings obtained in this analysis, parental achievement expectancies for the preschool child are apparent for educational endeavor. Thus, at one end of this dimension are parents who express expectancies for a higher minimum educational level, better grades in school, and an intention to send the child to college. Along with this, however, is an extension of the achievement expectancy to broader aspects of the child's behavior which include an intention that he always do his best, that he excel in competitive play, and that he play only with certain children (acceptable to the parent). The latter items imply the possibility of an application of pressure or "persuasion" that might accompany the aspiration for achievement.

Factor IV: *Rejection* vs. *Acceptance of the Child's Behavior.* A dimension of easygoing acceptance as opposed to demanding and rejecting behavior would most appropriately define this factor. The acceptance end of the dimension is characterized by the parent who readily praises the child whether he does something outstanding or not, tends to be nonpunitive, lets the child play with whatever toys or games he desires, and believes that a mother can hold an outside job and still provide good training for the child. The acceptance end of the continuum is also accompanied by a greater tendency for English to be the language spoken in the home. This factor bears some resemblance to a "democratic-authoritarian" or "permissive-restrictive" dimension discussed by other investigators in relation to those child-rearing practices thought to influence personality development (23, 26) and indicates a degree of stability for this dimension regardless of the specific rearing practices being evaluated.

Factor V: *Provision for the Child's Intellectual Needs.* Expressions by parents of the degree of willingness to plan and provide for the child's present and future needs would seem to be the essential element in this factor. At one end of this dimension are the parents who indicated that they are making financial preparation for college, desire a higher minimum education for the child, provide a separate play area in the home, as well as a library of children's books for his use, take him to places of interest and to playgrounds, and spend time reading to him. Paradoxically, perhaps, these same parents believe that a mother can work outside the home and still provide good training for the child, and they favor leaving the child with baby sitters.

Factor VI: *Dependence upon External Resources.* The loadings that are highest on this factor are associated with the items that deal with degree of willingness to send the child to nursery school as early as possible and the degree to which advice was desired for teaching the child new things. When these items are considered in conjunction with significant loadings on items that deal with use of material rewards to encourage the child to learn, a tendency to be punitive, reliance on toys for developing language and use of playtime as a means of teaching, one could make the assumption that the parents who score high on these items are those who would willingly turn to other resources than their own participation with the child as a means of getting him to learn. Thus, they may desire to avoid responsibility by turning to an external educational source (nursery school or experts), toys to do the teaching for them, and the expedient use of punishment and material reward.

2. *Family Correlates*

A second phase of the analysis consisted of identifying correlates of parental responses to the questionnaire with demographic characteristics. For this purpose, scale scores were obtained by summing over items having loadings of .33 or greater within each of the six subscales identified by the factor analysis. These subscale scores were in turn correlated with the demographic data (see Table 3). Similarly, responses from the open-ended and completion items of the second section of the questionnaire were quantified, and their relationship to the demographic variables was also determined.

The scale that served to differentiate most extensively between the various demographic variables was the one dealing with *provision for the child's needs.* From the significant correlations obtained it was found that mothers are more likely to score higher on this scale than fathers ($r_{pt.\ bis.} = .33$) and that the fewer the number of children in the family, the greater the provision for needs ($r = -.25$). This latter result is probably mediated by economic considerations, since the families of higher socioeconomic level tend to have fewer children. Provision for the child's intellectual needs was also positively correlated with the father's occupational level ($r = .22$) and the educational level of the mother ($r = .31$). In essence, parents who have achieved higher socioeconomic status are more likely (and probably better able) to provide for the child and to plan for his future. There is also a modest, but significant, correlation between sibling rank and providing for the child's needs ($r = .16$), indicating that the parents tend to score higher on this scale the nearer the child is to being firstborn.[2] The meaning and interpretation of this correlation, however,

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[2] In interpreting sibling rank, as used for this study, the higher the child's rank the nearer the child is to being firstborn.

TABLE 3
RELATION OF SCALE SCORES TO DEMOGRAPHIC DATA
($N = 203$)

Demographic variables	I Willingness to devote time	II Parental guidance	III Aspiration for achievement	IV Rejection *vs.* acceptance	V Provision for child's needs	VI External resources
1. Sex of parent respondent[a]	.38**	.45**	.10	.18*	.33**	—.02
2. Number of children	—.25**	—.13*	—.10	—.02	—.25**	—.10
3. Father's occupation	—.03	.09	—.11	.00	.22**	—.04
4. Father's education	—.04	.12	—.08	—.03	.29**	—.03
5. Mother's education	.07	.17*	—.01	.06	.31**	—.09
6. Mother's employment[a]	—.03	—.05	.05	.00	.12	—.11
7. Age of child	.10	.06	.00	—.16*	.03	—.09
8. Sibling rank	.21**	.23**	.10	.07	.16*	.17*
9. Sex of child[a]	—.01	.07	—.16*	.00	.00	.01

[a] Point biserial r's.
* Significant at .05 level.
** Significant at .01 level.

is essentially the same as presented above for the relationship of provision for needs to number of children, since number of children and sibling rank are very highly correlated ($r = .78$).

The extent to which parents provide *guidance* for the child is most highly correlated with the sex of the parent ($r_{pt.\ bis.} = .45$)—the mother obviously being the one who would exercise more of this function with the preschool child. There is a slight tendency for a greater degree of guidance to be provided the fewer the number of children in the family ($r = -.13$) and the closer the child is to being firstborn (i.e., higher ordinal position or rank: $r = .23$). It is also the mother of higher educational level who tends to provide her child with more guidance ($r = .17$).

As is logical, it is the mother rather than the father who displays a higher scale score for *willingness to devote time to the child* ($r_{pt.\ bis.} = .38$). Where there are more children in the family and the child is of lower sibling rank, there tends to be less devotion of time to the individual child ($r = -.25$ and .21 respectively), since it is likely that the available time must be shared among the other children in the family.

Parental *rejection* or *acceptance* of the child's behavior is found to be dependent upon the age of the child and the sex of the parent. Thus, it is the mother who tends to be more accepting of the child's behavior ($r_{pt.\ bis.} = .18$) and to display a higher degree of acceptance toward the younger child ($r = -.16$), a finding which is generally supported by previous research (6).

The degree to which parents express *aspiration for achievement* at these preschool age levels is very moderately related to the sex of the child ($r_{pt.\ bis.} = -.16$), with higher achievement expectation shown for sons. A similar magnitude of relationship is found between sibling rank ($r = .17$) and the dimension dealing with *dependence upon external resources*. Thus, parents tend to turn to external sources of assistance the closer the child is to being firstborn. One assumption would be that parental experience plays a role in the need to turn to outside sources of assistance in child-rearing, such that the more child-rearing experience, the less likely the parent would feel a need for guidance. It is interesting to note in Table 3 that the one demographic variable that failed to correlate significantly with any of the scale dimensions of cognitive-oriented rearing practices was the mother's employment status. This coincides with reported findings of a general lack of consistent relationship between the mother's employment status and measures of the child's intellectual capability or personality disturbance (15).

Analysis of the 10 items in the second section of the questionnaire provided results that are essentially consonant with those found above for the 50 items of the first section. The findings can be considered under three headings:[3]

a. Occupational aspiration. Parents of these preschool children anticipated significantly higher status occupations for sons than for daughter, with aspirations for the particular kind of achievement also differentiated by the sex of the child. That is, daughters were more frequently expected to achieve in artistic endeavors and sons in mechanical skills. (No significant difference was found with regard to sex of the child for desired achievement in intellectual skills.) It is the father's educational level which differentiated the parents' choice of occupational endeavor. In families with fathers of high educational level there was greater expectation of achievement by the child in artistic and intellectual skills as opposed to physical and mechanical skills.

b. Toys and books purchased. The reason for choice of toys differentiated between mothers and fathers—the mothers being more likely to choose a toy because of its educational value and fathers admitting to the choice on the basis of the toy being fun to play with. In purchasing books for the child the significant associations found indicated that the higher the educational level of the father and the higher the sibling rank of the child (nearer the firstborn) the younger the age of the child at the time books are purchased.

c. Aspirations for verbal development. This category constituted a set of items requiring the parent to estimate the age at which the child displayed (or would display in the future) a set of seven verbal skills (from "naming objects" to "reading a sentence"). Correlations of these age estimations with demographic data indicated that, for five of these verbal skills, when the child was older, of lower sibling rank, and where there were more children in the family, the parents tended to give significantly higher estimates of the age at which the various verbal skills developed (or would develop). One conclusion is that the estimates are tempered by past observation and experience with verbal development as a result of having an older child and/or more children in the family.

D. Discussion and Conclusions

An analysis of the items utilized in this assessment of rearing practices has resulted in the identification of fairly clear-cut and meaningful dimensions of parental behavior that are believed to influence a child's cognitive development. These dimensions can serve as a usable framework for future development of measuring instruments in this area of study, just as factor analyses of questionnaires devoted to measurement of the child's social and emotional adjustment have served such a purpose in the past (23, 25). The contrast between factors identified in the present study and those that have been identified from measures of noncognitive oriented parental practices reflects differences in scale characteristics and, quite obviously, the type of rearing practices measured. Of particular interest, however, is one dimension that seems to pervade all of the factor analytic studies, including the present study, and would appear to characterize a general mode of parental response to a wide range of child behavior. This is what has been termed here as the acceptance-rejection dimension and variously designated as the "permissiveness-strictness" factor (26), the "Love-Hostility *vs.* Control-Autonomy" model of Schaefer (24), and the "Democratic-Authoritarian" factor by several investigators (1, 12). The other factors of cognitive-oriented practices that were identified bear remote (if any) similarities to the interpersonal-social dimensions of rearing practice described for such widely used scales as the Parent Attitude Research Instrument (25) and the Fels Parent Behavior Rating Scales (23).

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[3] All results summarized under these headings are derived from chi-square or correlational analyses indicating significance at the .05 confidence level or better.

A dimension that can be considered fairly distinctive for the cognitive-intellectual phases of child-rearing is the degree of parent willingness to spend time with the child and to interact with him in a variety of situations. This should not have been an unanticipated factor (although it is not dealt with specifically in the literature), since many of the activities that are believed to further intellectual development require a reasonable degree of parental involvement with the child in order for these activities to be initiated and carried out. Other equally unique factors are those concerned with provision for the child's present and future intellectual needs and the imposition of guidance that structures activity in a meaningful way.

Despite the rather restricted range of socioeconomic level for the group utilized in this study, there were a number of demographic variables related to dimensions of rearing practice. The highest magnitudes of relationship were found to differentiate mothers from fathers in their rearing practices with the preschool child (*viz.,* fathers devote less time, provide less guidance, express less interest about the child's present or future cognitive needs, and tend to be less accepting of the child's behavior than the mother). Most of the other significant demographic differences were associated with family size and sibling rank of the child, both of which seem important in this pattern of parental practices. As has been pointed out previously, both the number of children in the family and the ordinal position of the child undoubtedly influence the extent to which a parent can engage in a variety of activities that inherently require sustained participation.

Only one of the six dimensions of cognitive-oriented rearing practices bore consistent relationships to the socioeconomic variables of fathers' and mothers' educational levels and fathers' occupational level. As would be expected this was the dimension dealing with provision for the child's present and future needs in intellectual growth. Restriction of the sample on a socioeconomic basis undoubtedly prevented a broader effect of SES variables through all the dimensions.

While it is possible to identify and describe the cognitive-related patterns of child-rearing within a defined social group, there still remains the broader problem of how these patterns of parent behavior influence specific forms of cognitive skill development in the child. Even though a moderate degree of relationship has been demonstrated for certain categories of rearing practice and subsequent intellectual development, there is an inability to predict the degree to which specific rearing techniques influence specific cognitive skills. It would seem that the determination of such relationships, with measures derived from both the home and laboratory settings, should constitute the focus of future research.

E. Summary

A sample of 203 parents of preschool children served as respondents for a 60-item questionnaire. Items dealt with parental practices that previous research findings had shown to be influential in childhood cognitive development. Fifty of the items which were in a Likert Scale format were factor analyzed and six factors extracted: willingness to devote time to the child, parental guidance, aspiration for achievement, rejection *vs.* acceptance, provision for the child's needs, and dependence upon external resources. The factors are relatively unique to this aspect of child rearing, when contrasted with prior research that has dealt with the influence of rearing practices on personality development.

Scale scores, derived from the factors, were found to be related in a logical pattern to family (demographic) characteristics that reflect socioeconomic status.

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INFANTILE SHOCK TRAUMATIZATION AND THE MITIGATING EFFECTS OF TRANQUILIZING DRUGS*[1]

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A. PURPOSE

The effects of early experience upon adult behavior have been widely assumed in child developmental theories, adopted extensively as etiological factors in clinical practice, and reliably established in studies utilizing a variety of experimental procedures. However, the exact nature of early experience effects and the process underlying these effects have not been definitively determined. For example, on the one hand, Denenberg and Levine espouse the position that extra stimulation in infancy enhances the adaptability of the organism to stressing agents experienced in adulthood (3, 10). On the other hand, Gauron has found in several experiments that rats manifested a learning deficit in adulthood on those tasks in which the early traumatic agent was an important component (5, 6, 7).

While the mechanisms are not clearly delineated, it is widely assumed in the literature and in clinical practice with patients that drugs are capable of reversing or arresting learned deficits. Regardless of whether the deficit resulting from early traumatization is a product of increased emotionality in the animals or whether it is a result of competing and inappropriate responses learned in infancy which interfere with subsequent learning, the administration of tranquilizing drugs to rats shocked in infancy should have some implications regarding the reversibility of early experience effects. The aim of the paper was to select some of the standardly used tranquilizing drugs and to determine their effectiveness for the purposes of the study.

The specific hypotheses of this study were (*a*) a consistent behavioral deficit would be obtained as a result of infantile shock traumatization—i.e., nonshock animals would demonstrate superior learning ability to shock animals on an avoidance conditioning task, and (*b*) this deficit would be lessened by

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drug administration—i.e., differences between shock and nonshock animals in learning ability would be cancelled out.

B. EXPERIMENT 1

1. *Method*

A total of 64 Sprague-Dawley rats of both sexes from 11 litters were assigned to an experimental and to a control group. Subjects were matched on the basis of sex and litter, by means of a split-litter technique. Animals in the experimental group received .2 ma of inescapable, constant current electric shock daily for three minutes from Days 10 to 25 in a shock box measuring 6-1/2 × 4-1/2 × 10 inches. Animals in the control group received the identical treatment as the experimental animals, including removal from the nest and handling, with the exception of the shock traumatization. Following weaning at Day 25, the rats were placed in standard laboratory cages with six same-sexed animals per cage. No experimental manipulations were carried out on the rats during the maturational period. Training on the avoidance conditioning task was instituted at 112 days. The avoidance conditioning apparatus was a two-chambered unit divided by a V-shaped sheet-metal barrier. The apparatus measured 9 × 24 × 10 inches. The conditioned stimulus was provided by a 10-volt house buzzer mounted in a position directly in front of the apparatus. The apparatus was automatically programmed by means of a Lafayette eight-bank timer so that the CS preceded the US by 5 seconds. The CS and US remained paired either until the animal jumped the barrier or until 25 seconds elapsed, at which time the trial was terminated. The intertrial interval ranged randomly around 30 seconds. Ten trials were administered per day. Training was terminated either when the criterion of 90 per cent correct responding was attained (specifically defined as a series of 18 of 20 correct responses) or when an arbitrary maximum of 200 trials was reached. Number of incorrect trials and response latencies were recorded.

Matched pairs of animals were randomly assigned to one of four drug-dosage groups: 2 mg/kg Chlorpromazine, 2 mg/kg Thioridazine, .4 mg/kg Prochlorperazine, and an equivalent volume of isotonic Saline. Findings in the literature and from the drug companies would suggest that these quantities represented equivalent dosage levels (2). The male animals averaged approximately 1/3 kg and the females averaged approximately 1/4 kg. Consequently, the males received .03 cc of solution, while the females received .02 cc. The drugs were administered each day subcutaneously in the flank by disposable needles and syringes. A minimum of 45 minutes elapsed between drug administration and the onset of avoidance conditioning training. Individual animals were identified by means of a color coding system applied to the tail. This technique assured that the investigators were not aware of the original early experience or the drug group assignment.

2. *Results*

Separate analyses of variance were performed on error scores and on the reciprocals of the latency measures. A Pearson product-moment correlation of —.02 computed between the error scores and the latency scores for all *S*s suggested that these are independent measures. Analysis of variance on the error scores revealed a significant main effect attributable to Drugs ($p < .01$) and a significant Sex × Treatment interaction ($p < .01$). It is apparent from Table 1 that the major source of the Drug effect arose from the fact that the Saline group made significantly fewer errors than every other group ($p < .01$ in every *t* test comparison). At the other extreme, the Prochlorperazine group made significantly more errors than every other group ($p < .01$ in every *t* test comparison). The error scores for the Chlorpromazine and the Thioridazine groups fell in an intermediate position and were not significantly different from each other. The significant Sex × Treatment interaction arose from the fact that the male shock rats made significantly more errors than the male nonshock rats ($p < .05$), while the female shock rats made significantly fewer errors than the female nonshock rats ($p < .05$).

TABLE 1
MEANS AND STANDARD DEVIATIONS OF ERROR SCORES ON AVOIDANCE CONDITIONING IN EXPERIMENT 1

	Male				Female			
	Shock		Nonshock		Shock		Nonshock	
Drug	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Saline	177.00	22.45	111.50	71.29	52.25	11.93	116.50	60.32
Chlorpromazine	178.00	18.49	147.25	48.64	158.25	57.47	139.00	51.30
Thioridazine	149.50	52.09	145.75	55.09	153.75	34.12	174.00	19.44
Prochlorperazine	192.75	8.62	194.75	6.70	163.25	30.20	190.00	16.02

Analysis of variance on the reciprocals of the latency measures revealed significant main effects attributable to Drugs and Treatment. Table 2 indicates that the direction of the Drug effect is similar to that obtained with the error scores. The significant Treatment effect arose from the obvious superiority of the nonshock group.

C. EXPERIMENT 2

The purpose of Experiment 2 was to determine whether minor tranquilizing drugs would be more effective in mitigating the deficit associated with infantile

TABLE 2
RECIPROCALS OF MEAN LATENCIES AND STANDARD DEVIATIONS ON AVOIDANCE CONDITIONING IN EXPERIMENT 1

	Male				Female			
	Shock (sec.)		Nonshock (sec.)		Shock (sec.)		Nonshock (sec.)	
Drug	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Saline	6.40	1.11	11.72	1.72	10.48	2.76	10.08	1.53
Chlorpromazine	6.28	1.22	9.10	2.15	7.52	2.50	9.12	2.08
Thioridazine	8.35	2.34	9.90	0.82	8.22	2.23	9.02	1.49
Prochlorperazine	5.98	1.84	6.66	2.62	7.42	1.52	8.37	1.26

shock traumatization than the major tranquilizing drugs had been. This expectation was in part derived from the hierarchy of differential drug effectiveness obtained in Experiment 1 and the finding that the least potent drug had been the most effective in lessening the deficit.

1. *Method*

The subjects were 64 Sprague-Dawley rats, evenly divided between the sexes, obtained from a total of nine litters. The procedure was identical to that described in Experiment 1 except that training on avoidance conditioning was instituted at 75 days and training on avoidance conditioning was terminated upon the completion of 150 trials in instances where the animal did not attain the criterion of learning. Analysis of the results of the previous experiment had indicated that training beyond 150 trials was of little benefit.

Matched pairs of animals were randomly assigned to one of four drug-dosage groups: 32 mg/kg Meprobamate, 2 mg/kg Hydroxyzine, .4 mg/kg Diazepam, and an equivalent volume of isotonic Saline. The suppliers of the drugs and our own Pharmacy Department have indicated that these quantities represented equivalent dosage levels of the drugs. The male and female animals received .02 cc of every solution except Meprobamate, of which they received .10 cc and .08 cc respectively. The drugs were administered each day subcutaneously in the flank by disposable needles and syringes. A minimum of 45 minutes elapsed between the time of drug administration and the onset of the avoidance conditioning training.

2. *Results*

Marked variability between litters was obtained, which led to the decision to use a Type III design (11). Separate analyses of variance were performed on the error scores and on the reciprocals of the latency measures. The analysis of variance of the error scores yielded a significant main effect attributable to Drugs ($F = 3.86$, $df = 3, 56$, $p < .05$) and a significant Sex × Drug interaction ($F = 6.74$, $df = 3, 56$, $p < .01$). Table 3 indicates that the Saline group made the fewest number of errors of all the groups. Separate t tests between the Saline group and the Meprobamate group and between the Saline and the Diazepam group barely failed to attain significance at the .05 level. Table 3 also indicates that the major source of the Sex × Drug interaction was the differential effect of Meprobamate and Hydroxyzine on the sexes.

TABLE 3
Means and Standard Deviations of Error Scores on Avoidance Conditioning in Experiment 2

	Male				Female			
	Shock		Nonshock		Shock		Nonshock	
Drug	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Saline	87.50	42.46	117.25	47.34	91.00	54.76	91.75	64.74
Hydroxyzine	78.75	50.06	98.00	55.26	137.75	15.82	108.50	40.60
Meprobamate	139.75	10.04	139.25	8.88	95.00	42.16	104.75	34.03
Diazepam	120.00	44.48	128.25	15.08	105.25	36.76	127.50	25.17

An analysis of variance on the reciprocals of the latency measures revealed significant main effects attributable to Drugs ($F = 7.00$, $df = 3, 56$, $p < .01$) and Treatment ($F = 21.08$, $df = 1, 56$, $p < .001$). A significant Sex × Drug interaction was also obtained ($F = 6.96$, $df = 3, 56$, $p < .01$). Table 4 indicates that the source of the Drug and Sex × Drug effects is identical to that described above. It can also be observed in Table 4 that the treatment effect was the result of the very obvious superiority of the nonshock group.

TABLE 4
Reciprocals of Mean Latencies and Standard Deviations on Avoidance Conditioning in Experiment 2

	Male				Female			
	Shock (sec.)		Nonshock (sec.)		Shock (sec.)		Nonshock (sec.)	
Drug	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Saline	9.83	2.19	9.59	2.16	9.05	4.09	10.94	3.34
Hydroxyzine	9.49	2.22	10.44	2.50	5.95	3.52	10.12	3.40
Meprobamate	4.56	3.11	8.20	1.42	7.61	3.72	10.78	0.96
Diazepam	7.02	2.73	8.90	0.76	6.36	2.78	9.04	1.31

D. Discussion

The first hypothesis that a deficit attributable to shock traumatization would be obtained was substantiated in both experiments with the exception of the error scores for the female rats in Experiment 1. This latter result is not easily interpretable, since the majority of investigators have tended to use only male rats in their drug research. One explanation for this tendency and also for our finding probably relates to the sexual cycle of the female with concomitant hormonal and physiological changes which interact with drug effects. This explanation received some support from the results of Experiment 2 where no main effects attributable to sex were obtained when sexually immature animals were used. However, the finding of differential drug effects in the sexes in Experiment 2 suggests that this issue is far from being resolved and that further exploratory research utilizing both sexes is still needed. In contrast to the findings of Levine and Denenberg, the production of a learning deficit as a result of infantile traumatization has now been repeatedly demonstrated. This type of result is also consistent with that obtained by other investigators (1, 8).

The second hypothesis that the deficit associated with early experience would be mitigated by the administration of drugs received some support. The position that the deficit produced by early experience is treatable was confirmed primarily with respect to the error scores. The initial and continuing differences in the latency measures may be reflecting the presence of competing responses in the shock animals. Because of their previous experience with inescapable shock, these animals no longer showed the most adaptive response of escaping as quickly as possible from the painful experience. This aspect of the deficit is apparently not as treatable by drugs as is the increased anxiety associated with the shock experience. In general, the minor tranquilizers were more effective in cancelling out the differences between the shock and nonshock animals than were the major tranquilizers. Specifically, among the minor tranquilizers, Meprobamate was most effective with the shock females, Hydroxyzine was most effective with the shock males, and Diazepam was consistently effective with shock animals of both sexes. With respect to differential effectiveness of the major tranquilizers, Chlorpromazine was not effective for the purposes of the study. Both Thioridazine and Prochlorperazine cancelled out the difference between the shock and nonshock animals. However, Prochlorperazine equated the animals in a negative direction with all animals making an extreme number of errors. It is entirely possible that the differential effectiveness of the minor and major tranquilizing drugs may be a product of the nature of the effects on the organism produced by the drugs. To the extent that the deficit may be modified by anxiety reduction without other untoward side effects such as drowsiness and impaired motor responses such as are produced by the phenothiazines, then drugs are effective for the purposes of the study.

Regarding the effects of the drugs on response acquisition, the results suggested a hierarchy of interference with new learning with the minor tranquilizers exerting less of an influence than the major tranquilizers. Within the phenothiazine group, Thioridazine exerted the least effect on new learning, while Prochlorperazine interfered the most. This aspect of the results is in general agreement with the findings of previous investigators that the phenothiazines interfere with the acquisition of an avoidance response (4, 9).

The considerable variability among litters is worthy of additional comment. In some instances, differences between litters were larger than those between drug or treatment groups. When differences of such magnitude are obtained between animals of the same species and same strain in the same study, the problems inherent in making comparisons between studies done by different investigators at different laboratories become readily apparent. It would seem that the utilization of a split-litter technique to control the amount of variation attributable to hereditary factors is an absolute essential to studies investigating both early experience and drug effects.

E. SUMMARY

The purposes of this experiment were to establish that infantile shock traumatization produces a learning deficit in adulthood on an avoidance conditioning task and to explore whether tranquilizing drugs would be effective in lessening this deficit.

In each of two experiments, half of the 64 rats were exposed to .2 ma of inescapable shock daily from Days 10 to 25 of life. Later in life all the animals received training on an avoidance conditioning task. In Experiment 1 the drug-dosage groups were 2 mg/kg Chlorpromazine, 2 mg/kg Thioridazine, .4 mg/kg Prochlorperazine, and Saline. In Experiment 2 the drug-dosage groups were 32 mg/kg Meprobamate, 2 mg/kg Hydroxyzine, .4 mg/kg Diazepam, and Saline. Injection of drugs occurred 45 minutes prior to the onset of avoidance conditioning each day.

The results generally supported the occurrence of a deficit attributable to the early shock experience, particularly on the latency measures. The drugs were differentially effective both for the purposes of the experiment and in affecting new learning. The minor tranquilizing drugs were more effective than the major tranquilizing drugs in cancelling out the learning deficit manifested in differences between the shock and nonshock groups.

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CONSERVATION OF SUBSTANCE IN NORMAL AND MENTALLY RETARDED CHILDREN*[1]

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A. INTRODUCTION

Current interest in the Piaget and "Geneva-school" formulations of concept development is familiar to everyone who works in the human development area. One concept that has generated considerable research interest is that of conservation of substance. A child is said to have acquired this concept if he can tell that a quantity remains the same (is conserved) after it is changed in appearance. One test for this concept is to alter one of a pair of identical clay balls in various ways, and then ask the child whether the amounts are the same or different. The Geneva school suggests that this concept is one of several acquired during the concrete operational stage—the second of three stages of cognitive development. During this stage the child progresses from the intuitive phase where he seldom grasps the abstractions necessary to understand conservation of substance to a transitional state where he vacillates between an answer that indicates conservation and one that does not, to a final phase where he masters the concept and is even able to reverse logically the processes involved (4, 5).

Piaget's observations have been subjected to several systematic replications. Carpenter (2), Elkind (3), and Lovell and Ogilvie (7) have all confirmed the succession of stages reported by Piaget. However, the ages at which specific stages are reached and the stability of conservation responses at different ages have not been agreed upon. This lack of agreement suggests that factors other than maturation are operating in the formation of this concept. Some of the other factors that have been suggested are experience, educational transmission, and "equilibration."

Several investigators have attempted to accelerate concept formation by giving a child specific experiences in a laboratory situation. Jan Smedslund

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(8) was able to instill the concept of conservation of weight in children who, prior to the experience, were not conservers. However, in a subsequent experiment, Smedslund (9) showed that those who had learned the concept "artificially" quickly relinquished it when confronted with evidence at variance with what they had learned. Other children who had acquired the concept "naturally" resisted the experimenter's attempts to extinguish the conservation response. These findings reinforced Smedslund's position that experience alone will not lead to stable concepts. However, Wohlwill in a number of studies (11, 12, 13) has shown that training can help the child attain conservation of number and weight. Wallace has also presented evidence that suggests that number concepts can be acquired prior to the age levels designated by Piaget. These studies and a number of others which attempt to assess the role of experience in concept formation are reviewed by Wallace (10).

There are two areas that have been consistently neglected in the literature and that ultimately are of considerable importance to the research in concept development and its application to the fields of learning and education. One of these is the area of "natural" experience as opposed to artificial, concentrated experiences, such as those received in a laboratory. Most of the studies that have looked at experience have been confined to specific laboratory situations which are not at all comparable to the life experiences that occur naturally during childhood. Typically, childhood experiences in a specific area extend over a longer period of time and are integrated with other experiences. Certainly it is desirable to examine the effect that the more natural experience has on concept development.

The second area that has been neglected in research on concept development is the mental age of subjects. Past studies have focused on the chronological ages at which a child masters conservation. Chronological age has been shown to be an unsatisfactory index of concept development, yet no attempt has been made to control for the mental age or intellectual development of the child.

B. Method

The present study was designed to investigate whether two groups of children with the same mental ages but with varying amounts of life experience would differ in their understanding of conservation of substance.

1. *Subjects*

The first group of *S*s were 21 mentally retarded children from the Woodward (Iowa) State Hospital and School. According to the system of classification of the American Association for Mental Deficiency, all of these children were either "cultural familial" or there was "no known cause" for their retardation. *S*s were selected from these two categories to minimize the possibility of known brain damage. To qualify as *S*s these children had to have a mental age between 5 and 11 years. This criterion was set on the basis of Elkind's (3) findings that less than 20 per cent of the children below the chronological age of 5 are conservers of substance and that over 90 per cent of the children at age 11 are conservers. A total of 12 males and nine females satisfied these criteria. The chronological ages of these *S*s ranged from 13 years-zero months to 28 years-8 months. Their mental ages, as determined by the Peabody Picture Vocabulary Test (PPVT) ranged from 5 years-3 months to 10 years-10 months.

The second group of *S*s were 21 children enrolled in the Boone (Iowa) public schools. These children were carefully selected so that their mental ages were within six months of their chronological ages. This was done by selecting all those children who performed at the 50th percentile for their grade level on various standardized tests routinely administered by the school. *S*s selected in this manner were then given the Peabody Picture Vocabulary Test (PPVT). If the mental age achieved on the PPVT and the child's chronological age differed by less than six months, the child was matched to one of the retarded *S*s. The children finally selected as *S*s were between 5 and 11 years of age. The final subject group, then, was composed of 21 normal *S*s matched according to mental age with a group of 21 retarded *S*s. It was not possible in all cases to match the sex of the pairs. Thus eight of the 21 pairs are not of the same sex. Table 1 shows the CA and MA of the two groups of *S*s. In no instance does the mental age of the two paired *S*s differ by more than four months. In 14 of the 21 pairs the difference in mental ages is two months or less. The chronological age distributions ranged from 5 to 11 years for the normal *S*s and from 13 to 28 years for the retarded *S*s. Since these distributions do not overlap at all, it is obvious that their means are significantly different.

2. *Procedure*

The Peabody Picture Vocabulary Test and six conservation of substance tasks were administered to 42 *S*s in individual sessions. The PPVT was used to determine a MA for each *S*. Then the child's understanding of the concept of conservation of substance was ascertained by administering the conservation tasks.

The children were tested individually in an isolated room, with the child

TABLE 1
CHRONOLOGICAL AND MENTAL AGES OF SUBJECTS

Retarded subjects		Normal subjects	
Chronological age	Mental age	Mental age	Chronological age
15-1	5-3	5-3	5-6
13-2	7-0	6-10	6-10
15-4	7-7	7-5	7-11
15-6	8-0	8-2	7-8
22-10	8-2	8-4	8-8
21-2	10-7	10-4	9-10
28-8	10-2	10-1	10-0
15-5	6-8	6-4	6-7
17-9	6-8	6-4	6-2
16-10	9-6	9-6	9-0
23-3	8-6	8-6	8-3
20-6	9-6	9-4	9-5
17-10	6-4	6-2	6-7
24-1	7-3	7-5	7-2
20-7	9-6	9-4	8-10
21-10	10-10	10-10	10-5
13-0	8-2	8-6	9-0
23-9	7-10	8-2	8-8
20-11	10-7	10-10	10-11
20-0	5-11	5-10	5-10
25-4	9-10	10-1	10-1

and *E* sitting opposite each other at a small table. Each session lasted between 15 and 20 minutes.

The procedure was as follows. First, the PPVT was administered according to the instructions in the manual. Then two green plasticine balls, equal in size, weight, and volume were presented to the *S*. The *S* was told, "Here are two balls of clay. They are exactly the same." *E* paused to allow *S* time to examine the balls. "Now I am going to change this one." One of the balls was transformed into a sausage approximately nine inches long. Then the child was asked, "Now do both of these have the same amount of clay: that is, is there as much clay in this one as there is in this one?" Throughout the session *E* pointed to each of the balls when asking *S* this question. After the *S* had responded, *E* asked in a neutral manner, "Why is that?" Then *E* continued, "Now I'm going to cut this (sausage) into two pieces. Do these two pieces have the same amount of clay as this one: that is, is there as much clay in these two as there is in this one? Why is that?" The transformed sections were then removed and another ball of plasticine, again equal in size, weight, etc., was presented. Exactly the same procedure was repeated except that the second and third transformations were shaped like a pancake (five inches in diameter) and a donut (three-and-one-half inches in diameter with a hole in the center), respectively. In each case *S* watched the transformation take place. The entire procedure was performed slowly so that *S* could watch the change take place.

All of the responses which *S*s made to conservation questions were recorded so that they could be categorized later by two judges. The tape recorder was turned on immediately after the PPVT had been administered and was allowed to run until the end of the session. All of the children's answers were classified as correct or incorrect and their explanations were independently judged by two psychologists as fitting into one of four categories.

The four categories of explanations used in the present experiment were first used by Smedslund (8, p. 74).

> 1. Symbolic-logical (S-L): All symbolic explanations which explicitly state that nothing has been added or taken away, or which in any other way contain an explicit reference to necessity. Example: "It has to be the same, always."
> 2. Symbolic (S): All explanations which directly or indirectly refer to previous events in the same test item. Example: "You did not take anything away."
> 3. Perceptual (P): All explanations that directly or indirectly refer to observable features of the situation. Example: "It is bigger."
> 4. Ambiguous (A): All explanations that cannot be subsumed under the preceding categories. Example: "I don't know."

C. RESULTS

For each *S* the judges were asked to evaluate the answer given and the type of explanation given. In order to evaluate the extent to which the two judges agreed in categorizing responses, the frequency with which the judges should have agreed by chance and their actual levels of agreement were compared by means of a chi square. Theoretically the number of *S*s for which the judges could be expected to agree on three or more responses is less than .18. Actually the judges agreed on three or more of the responses for 38 of the 42 *S*s. They agreed on all six responses 18 times, on five responses nine times, on four responses eight times, on three responses three times, and in four cases they agreed on only one response. A chi square between the expected and observed levels is significant beyond the .001 level. It should be noted that most of the disagreement concerned ambiguous responses. If these responses are excluded, the judges agreed on 92 per cent of the responses.

A summary of the responses of the *S*s is shown in Table 2. The retarded group gave a total of 160 yes responses out of a possible 252. In comparison the normal group gave 191 yes responses. The normal *S*s gave 183 symbolic (S) responses compared to 124 for the retarded group. Ambiguous (A) re-

TABLE 2
SUMMARY OF EXPLANATIONS GIVEN BY SUBJECTS

Responses	Retarded subjects	Normal subjects
Number of yes responses	160	191
Symbolic Logical (S-L)	14	4
Symbolic (S)	124	183
Perceptual (P)	81	53
Ambiguous (A)	33	12

sponses were given 33 times by the retarded group and only 12 times by the normal group. The retarded *S*s gave perceptual (P) responses 81 times, while the normal group gave perceptual responses 53 times. Finally, the retarded group gave 12 symbolic-logical (S-L) responses, while the normal group gave only four such explanations.

Nine of the retarded and 13 of the normal *S*s gave 10 or more symbolic (S) or symbolic-logical (S-L) explanations out of the 12 possible. If this is used as the criterion for saying a child is a conserver, then 22 of the 42 *S*s were conservers. Excluding those cases where both members of the pair were conservers, it is seen that nine of the normal children were conservers, while their retarded counterparts were not. Also five of the retarded children were conservers, while the normal *S*s they were matched with were not. A sign test shows that this distribution has a probability of .21 of occurring by chance.

Table 3 shows the results of sign tests used to evaluate the different kinds of explanations given by the *S*s. In the case of the symbolic-logical (S-L) explanation, six of the retarded *S*s and three of the normal *S*s gave more of this kind of response than did their matched counterpart. More symbolic (S) explanations were given by 13 of the normal *S*s and six of the retarded *S*s. Eight of the retarded *S*s and six of the normal *S*s gave more ambiguous (A) responses than did the *S*s they were matched with. Perceptual (P) responses were given more often by eight of the normal *S*s and also by eight of the retarded *S*s.

TABLE 3
SUMMARY OF SIGN TESTS

Explanation given	Differences in favor of retarded *S*s	Differences in favor of normal *S*s	Probability
S-L	6	3	.254
S	6	13	.084
P	8	8	.598
A	8	6	.395
No. of yesses	7	9	.402

Note: S-L = symbolic logical; S = symbolic; P = perceptual; and A = ambiguous.

Since the retarded children had such difficulty formulating verbal explanations, the number of yes responses given by the two groups of *S*s was also compared. In nine instances, the normal *S*s gave more yes responses than did their retarded counterparts. In seven cases the retarded *S*s gave more yes responses than did the normal *S*s with whom they were matched. Therefore, even though the retarded children had had more life experience, their responses do not show greater understanding of the concept of conservation of substance.

A second aspect of this study concerned the role of mental age in concept development. Table 4 shows the results of Spearman rank-order correlations between mental age and several other factors. Increasing mental age correlated .70 with number of yes responses, .63 with number of symbolic responses, and —.64 with number of perceptual responses. All of these correlations are significant beyond the .01 level. Thus, understanding of the concept of conservation of substance correlated very highly with the mental age of the *S*.

TABLE 4
SUMMARY OF CORRELATIONS

Responses	Mental age
Total number of yes responses	$r_s = .701$**
Total number of S responses	$r_s = .633$**
Total number of P responses	$r_s = —.636$**

** Significant beyond the .01 level.
Note: (N = 21). S = symbolic; P = perceptual.

D. DISCUSSION

One of the purposes of this study was to investigate concept formation in terms of years of life experience. The retarded population had lived an average of 11.41 years longer than the normal *S*s with whom they were matched. Even with this differential in terms of years lived, the retarded group still had no better grasp of the concept of conservation of substance than did the normal *S*s with whom they were matched.

There are several possible explanations for this. The first concerns the different kinds of experience which the two groups have been exposed to. All of the children in the retarded group were in an institution at the time of the study. Most of them had been there for several years; some, since infancy. It is widely recognized that institutionalized children are exposed to a less stimulating environment than are normal children. Thus, lack of stimulation could be a factor; perhaps the children had not had the experience necessary to develop the concept. However, the average retarded *S* had lived 19.66 years, while the average normal *S* had lived only 8.25 years. If experience were the relevant factor in concept development, it would seem that even a minimally stimulating environment would lead to this type of concept formation in 11 additional years.

A second possible explanation is that the retarded *S*s had developed the concept, but were unable to communicate it to *E*. This possibility is given some credence by the following observations. The responses given by retarded *S*s were more often judged ambiguous than were responses given by normal children. The retarded children frequently had speech impediments that made their answers difficult to understand and, therefore, difficult to judge. In addition some retarded *S*s maintained adamantly that the two pieces of clay contained the same amount; however, when asked "Why?" they were literally at a loss for words. On the other hand the comparison of the total number of yes responses between the retarded *S*s and the normal *S*s (see Table 2) still shows the normal *S*s with a sizeable advantage.

A third possible explanation concerns structural, neural, or some other physiological inabilities of the retarded *S* which keep him from processing the information the environment provides. Kurt Lewin (6) stated that mental age determines the degree of differentiation within the "inner core" of the person, while chronological age determines the flexibility or permeability of the boundaries within the core. Thus, the mentally retarded *S* in this study would have no more differentiation than the normal *S* with whom he is matched. Also, according to Lewin's theory, the boundaries of the retarded *S* would be more rigid and he might be incapable of assimilating experiences that could lead to the development of conservation of substance. Hebb suggests that the neural development of the retarded child is immature and that the retarded *S* has "a diminished capacity for the integration of complex neural circuits at different levels of the nervous system" (1, p. 562). This would also explain an inability to profit by experiences in which conservation of substance was demonstrated. Piaget has suggested an internal and external balance system, a state of equilibrium between the organism and the environment which is maintained throughout the various stages of concept formation. If the organism cannot "assimilate" the stimulation the environment is producing, then such stimulation is wasted. When this fact is applied to the present study, it seems likely that the retarded child has had many experiences with conservation of substance, but is not capable of assimilating the experiences and generalizing from them.

This third hypothesis is further supported by the significant correlations obtained between (*a*) mental age and number of yes responses (+.701), (*b*) mental age and number of symbolic responses (+.633), and (*c*) mental age and number of perceptual responses (—.636). It is evident from these correlations that the chronological age of a *S* is not the only factor in his concept development. The intellectual abilities of a child must also be taken into consideration. Before a child can develop the concept of conservation of substance, he must be able to ignore or explain to himself the misleading perceptual cues he is receiving. Again, it seems that a certain level of mental functioning must be reached before the child can perform this logical operation. In short, the results of this study indicate that mental age is an important factor in the development of the concept of conservation of substance. This is an important finding in an area where researchers make a practice of plotting the stage of concept development in terms of chronological age. Perhaps the variance would be more efficiently accounted for if a *S*'s mental age were used to plot the level of concept development.

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PSYCHOMETRIC EVALUATION OF AN OPERATION HEADSTART PROGRAM* [1, 2]

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A. INTRODUCTION

In 1940, a volume of research investigations was published (16) which dealt with the effects of nursery school attendance upon changes in intelligence test scores. Many of these investigations seem to have been provoked by the controversial research reported by Wellman (15).

More recent investigations of the effects of preschool education have had as a focus what is done in the preschool situation and to whom, rather than the earlier focus upon preschool attendance *per se*. The intent of the recent research appears to be the study of preschool activities presumed to be related to subsequent school performance expectations, and with specific intellectual functions for specific groups of children with demonstrated deficiencies.

Not uncommonly, recent experimental or trial preschool programs have focused upon language development with children shown to be deficient in language usage (5, 12). Several programs have recently emphasized language development and general perceptual development with low socioeconomic racial-minority-group children (2, 6, 9, 10). The point is that contemporary research has focused upon organized and programmed treatment programs for lower socioeconomic subjects rather than upon whether or not subjects had or did not have some type of preschool educational experience. Even though the foci of investigations of effects of preschool educational experience have changed, the short-term criterion measures used to evaluate programs have remained essentially the same. Many of the 1940 studies reported in Whipple (16) involved the use of individual intelligence test data to evaluate preschool effects. Studies in the 1960's also employed the same type of measures (1, 9).

It is presumed that the continued use of individual intelligence tests as eval-

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[1] Adapted from a thesis completed by the first author under the direction of the second author, and submitted to the Department of Psychology, San Jose State College, in partial fulfillment of the requirements for the Master of Science degree.

[2] Psychological test data for this study were obtained under Project 3102, Contract OE-6-10-118, Cooperative Research Branch, U.S. Office of Education (13).

uative devices is due to the repeated finding that scores from these measures correlate higher with indices of educational performance than with any other nontest validation criteria.

The preschool program of this study was a part of project Operation Headstart of Summer 1965. Over 500,000 children across the country participated in the Operation Headstart program that first summer of this massive federally sponsored preschool program for children with presumed learning deficiencies.

The primary problem of the current study was to determine if a short-time, enriched preschool program (Operation Headstart) improved the likelihood of school success as predicted from an increase in individual intelligence test scores for treated subjects.

B. Procedure

The program with which this study is concerned was carried out at the Mayfair School in San Jose, California. The Mayfair School attendance area is primarily composed of families whose children are those for whom the national Operation Headstart program was established. The attendance area is composed mainly of Mexican American families, and has been described as blighted (4) and as a Western ghetto (13).

1. *Selection of Operation Headstart* Ss

The children who participated in the Mayfair Operation Headstart program were those who had been preregistered for the Fall 1965 kindergarten classes at the Mayfair School. In order to qualify for inclusion into the program, two criteria had to be met: (*a*) the annual income of the child's family could not exceed $3,000.00, and (*b*) the child's parents had to agree to remain in town all summer, thereby enabling their child to attend the program on a daily basis. The first 45 children on the preregistration list who met the selection criteria were formed into three classes with 15 children in each. Since one child was taken out of the program a few days after it began, only 44 children were tested at the beginning of the eight-week program. Eleven of these moved away from the school attendance area, and 33 subjects were retested with the same instruments 90 to 120 days later while in kindergarten. The participants in the program who stayed in the area and were enrolled in kindergarten at Mayfair School in September 1965 were considered the experimental subjects and will hereafter be referred to as Operation Headstart subjects or OHS.

2. *Selection of Comparison* Ss

Ideally, a sample of children meeting the same selection criteria as were met by the OHS, but not in any preschool program should have been selected and tested both before and after the Operation Headstart program. However, this was impossible due to the hurried implementation of the program both locally and nationally for this first year. Therefore, it was necessary to select an *ad hoc* matched comparison group. Before any test data had been tabulated, the selection of the matched comparison group was made by the second author from information accumulated for the entire kindergarten at the beginning of the school year. Subjects were matched with the OHS on four factors: (*a*) sex, (*b*) chronological age within 60 days, (*c*) parental occupational level as categorized by the Hollingshead and Redlich (11) system, and (*d*) parental ethnic-racial origin. The comparison *S*s participated in the testing program of the entire kindergarten of the Mayfair School at the same time the OHS were tested in the same kindergarten classes. Hereafter, the matched comparison group will be designated MCG.

3. *The Program and Teachers*

As in the regular school program, the teachers for the Mayfair School Operation Headstart program were qualified and experienced professionals. All three teachers had taught in primary grades in the area, and were familiar with behavior patterns of the group participating in the program. In preparation for teaching in the program, all three teachers attended a week-long training and orientation program. This training consisted of lectures regarding the cultural background, educational deficiencies, and behavior patterns of their future pupils; class demonstrations; and the making of teaching aids.

There was very little emphasis placed upon preparing the OHS for school *per se* as most of their activities were self-directed and not organized. The only group or planned activities were song and story times, and selected field trips.

4. *Psychological Tests Used*

All of the children participating in the Operation Headstart program at Mayfair School were given three individual tests near the beginning of the project sessions. The tests were the *Stanford-Binet, LM* (14), the *Peabody Picture Vocabulary Test: Form A* (7), and the *Pictorial Test of Intelligence* (8). The first administration of the test to the OHS in July 1965 is called Testing Session I (TS I). In October and November of 1965—Testing

Session II (TS II)—the same tests were administered to each child in the kindergarten classes at Mayfair School. In addition, from December 1965 to January 1966, a new test was also given to each kindergarten student. The new scale used in Testing Session III (TS III) was comprised of a verbal half and a performance half and was still in the process of national standardization. The test author, name, and distributor are unidentified by agreement with all parties concerned, and the test will herein be called the EX test.

All testing was accomplished without examiners' knowing which children had been in Operation Headstart and which children had not. One team of examiners did the initial testing (TS I), and a second team the "in kindergarten" testing (TS II & TS III).

5. *Comparisons Made and Statistical Procedures Used*

There were two sets of analyses conducted. One measure of the short-term effects of the OH program was to determine whether there were mean gains on the three individual intelligence tests for the 33 OHS over the 90 to 120 days. Such comparisons were made for TS I *vs.* TS II.

A second measure of the short-term effects of the OH program was to compare the "in kindergarten" test performance of the OH group with that of subjects like the OHS who had not had the OH experience. Four such comparisons were made.

The correlated *t* test procedure was used for both sets of analyses. This statistical procedure was considered appropriate because for the test-retest comparisons the scores on the two occasions were obtained from the same individuals and, for the latter comparisons, the *S*s of the two groups were individually matched.

C. RESULTS

1. *TS I* vs. *TS II Analyses*

As indicated, *t* tests of the significance of the difference between correlated means were computed for the TS I-TS II analyses for the OH sample. The results of these analyses are found in Table 1.

As is easily seen, all three test-retest analyses yielded statistically significant mean gains beyond the .01 level. The greatest gains occurred for the PPVT and the PTI tests. The mean gain on the PPVT is particularly noteworthy because it was larger than the average of the two standard deviations for TS I and TS II.

TABLE 1

SB-LM, PPVT, and PTI Three-Month Test-Retest Comparisons for Operation Headstart Subjects ($N = 33$)

Test	Mean TS I	Sigma TS I	Mean TS II	Sigma TS II	r TS I-TS II	Mean diff. TS I-TS II	t
SB-LM *IQ*	91.16	14.08	94.91	12.92	.88	3.75	3.18**
PPVT *IQ*	76.44	17.59	94.72	14.22	.60	18.28	7.13**
PT I *IQ*	85.58	13.11	93.58	12.61	.74	8.00	4.35**

** Sig. beyond .01 level.

Note: SB-LM = Stanford-Binet, LM; PPVT = Peabody Picture Vocabulary Test; PT I = Pictorial Test of Intelligence; TS I = Testing Session I; TS II = Testing Session II.

2. *Matched-Pair Analyses*

The correlated t test comparisons for the matched-pair analyses are found in Table 2.

TABLE 2

SB-LM, PPVT, PTI, and EX-Test Comparisons for Operation Headstart and Matched-Pair Subjects ($N = 33$)

Test	OH subjects Mean	OH subjects Sigma	MCG subjects Mean	MCG subjects Sigma	r OHS-MCG	Mean diff. OHS-MCG	t
			TS II				
SB-LM *IQ*	94.97	12.97	91.06	11.43	.26	3.91	1.17
PPVT *IQ*	94.55	14.32	86.91	15.79	.03	7.64	2.02*
PTI *IQ*	93.84	13.00	87.50	14.76	.07	6.34	1.89*
			TS III				
EX Verb. X	65.50	16.81	58.63	22.12	.05	6.88	1.43
EX Perf. X	31.81	10.62	23.84	9.52	.09	7.97	3.03**

* Sig. beyond .05 level.

** Sig. beyond .01 level.

Note: SB-LM = Stanford-Binet, LM; PPVT = Peabody Picture Vocabulary Test; PT I = Pictorial Test of Intelligence; OHS = Operation Headstart subjects; MCG = Matched Comparison Group; EX = new unpublished test; TS II = Testing Session II; and TS III = Testing Session III.

Careful inspection of the data in Table 2 yields several relevant observations. Of primary interest is the fact that the means for the OHS are numerically higher than those for their matched pairs. Three of the five comparisons reached acceptable levels of statistical significance.

D. DISCUSSION

The mean intelligence test scores of the OHS were significantly higher after participating in the Operation Headstart program and attending kindergarten for six weeks than they were at the beginning of the program. These comparisons seem to indicate that there was some positive effect of the OH program upon the intelligence test scores of the participants. Also, at Testing Session II and Testing Session III, three out of five comparisons were statistically significant, and all five favored the OHS over their matched "in kindergarten" pairs. Again, these comparisons seem to indicate a positive effect of the OH program.

It is of interest to note these apparent short-term positive advantages for the OHS and to remember that there was little formal planning of the OH activities. Other investigations wherein extensive planning of activities and programming of these activities occurred have also yielded positive results with the same or similar short-term criterion measures (1, 2, 3, 5, 9). It would seem that the major evaluation task for investigators is to determine which set of arrangements yields the most positive results over a short period of time and, more importantly, which yield the most enduring positive results for the treated subjects.

E. SUMMARY

This study was a psychometric evaluation of an Operation Headstart program during the summer of 1965 at the Mayfair School in San Jose, California. Due to the late local and national implementation of Operation Headstart in its first summer, little formal planning and programming of summer preschool activities was possible. The OHS were left somewhat to their own resources; the activities with the exception of story and music times and selected field trips were largely self-directed.

Prior to and during the first few days of the OH program, in Testing Session I (TS I), all of the participants were administered the *Stanford-Binet, LM* test, the *Peabody Picture Vocabulary Test,* and the *Pictorial Test of Intelligence.* In order that it might be determined whether the program had affected the participants' intelligence test scores, the same battery was administered in October and November 1965—Testing Session II (TS II)—to the entire kindergarten at the Mayfair School wherein the OHS were students. In addition, in December 1965 and January 1966—Testing Session III (TS III)—a new and unpublished individual intelligence test with a verbal and performance part herein called the EX test was administered to all kindergarten *S*s at the Mayfair School.

The experimental group (OHS) was composed of 33 preschool subjects who not only attended the Operation Headstart program at Mayfair School, but also attended kindergarten there. A matched comparison group (MCG) also attended kindergarten at Mayfair School, but the members had not been

in any preschool program including the Operation Headstart program. The groups of matched pairs were matched on sex, age, parental occupational level, and their racial-ethnic origin.

Through the use of *t* tests for the significance of the difference between correlated means it was found that (*a*) the intelligence test means for the OHS were significantly higher for TS II than for TS I, and (*b*) the intelligence test means for the OHS were all higher than for the MCG, and three of the five were statistically significantly higher.

Both sets of analyses seemed to indicate a positive effect for the OH program. Because the OH program under observation was largely unplanned and unprogrammed, it was suggested that future investigations will need to be designed in such a way as to determine which set of preschool arrangements will yield the most positive results of a short-term and long-term nature.

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AUDITORY PERCEPTUAL ABILITY OF NORMAL CHILDREN AGED FIVE THROUGH EIGHT*

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A. Introduction

In preliminary research on auditory perceptual ability (6), the investigator discriminated between neurologically impaired and normal subjects on a test using interrupted speech signals. The stimuli consisted of speech waves turned on and off by the amplitude modulation technique described by Miller and Licklider (2). Except for two children, aged 5 and 10, all subjects in that preliminary investigation were adults. The purpose of the investigation here reported was to obtain normative data on response to similar stimuli by subjects aged 5 through 8.

The few studies that have been made of developmental scales for auditory perception, particularly that of Templin (4), support the assumption that auditory perception can be expected to improve with age in normal young subjects.

Miller and Licklider's technique of rendering hearing conditions difficult by modulating the amplitude of speech signals is particularly suitable for investigating the ability to use minimal auditory cues. The significance of such cues is shown in the common situation where, despite the filtering out by background noises of considerable portions of discourse, it is still possible to have meaningful reception of speech.

Miller and Licklider (2) investigated the intelligibility of interrupted speech in adults, but the problem merits further investigation with young subjects, particularly those in nursery or kindergarten settings. Here, because the children have not yet acquired reading skills, they are much more dependent on auditory signals than they will be later.

Typical of the techniques for creating difficult hearing conditions reported in the literature of auditory perception in children are (*a*) masking by background noises, which render portions of an otherwise intelligible sound or words partially or completely inaudible (3); (*b*) protracting the interval between parts of words and thereby disrupting the ease with which chains of

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sound are formed into words (1); and (*c*) presenting sets of two words or phonemes that are sufficiently similar in sound to challenge ability to discriminate between the two stimuli (5, 4).

The stimuli produced by the technique of amplitude modulation in the present research were tape-recorded words, parts of which had been made completely inaudible because of selective erasing. Since the words used are familiar, the subject is required to draw upon his presumed previous experience with the stimulus word in order to supply a part needed to form an integrated whole.

B. METHOD

1. *Subjects*

The subjects consisted of 80 children (40 boys and 40 girls), 20 at each chronological age level—5, 6, 7, and 8. All were of middle socioeconomic level as determined by Hamburger's revision of Warner's scale, and English was the only language spoken in their homes. Their school records showed no abnormalities in hearing, health, school achievement, or intelligence. All had scores between 95 and 105 on the Peabody Picture Vocabulary Test (PPVT), Form A, which was administered by the investigator.

2. *Materials and Procedures*

The stimuli were 110 tape-recorded words familiar to the children. Because of the age of the youngest subjects, many words included in the original investigation with adults (6) could not be used. For example, participial forms such as "blowing" or "climbing," which are among the first 40 words of the PPVT, although recognized under nondistorted conditions, seemed uniformly difficult for 5-year-olds when amplitude was modulated. Therefore only simple nouns were used. Some words were taken from among the first 40 words of the PPVT, others from story books or names of common objects in the children's environment. The procedure for selecting words was similar to that used by Templin (4). An excellent analysis of limitations proposed in auditory perception research with very young children is contained in her study.

The number of lists required to accommodate the different amplitude modulation conditions (with one list to a condition), and the limited vocabulary of the children, precluded the construction of lists that were phonetically balanced. However, the investigator did try to keep the lists from inadvertently generating predictable patterns of sounds.

Only words recognized by every subject in a pilot group of 5-year-olds ($N = 10$) were used in the final lists. The investigator determined whether or not the words were known to the subjects in this investigation by presenting them without amplitude modulation and asking the subjects to select the one appropriate picture out of four shown with each stimulus word.

The stimuli were divided into 10 groups of 11 words each, with various combinations of speech-time fraction settings and rates of interruption. "Speech-time fraction settings" represent the proportion of time speech is on: that is, various advantages of auditory blackout of the stimulus word. "Interruptions per second" (ips) is the frequency of interruption, a distribution of the stated percentage of blackout in discontinuous amounts spaced more closely (three ips) or less closely (two ips) over the length of the stimulus word. Each group of 11 words was presented at one of the following speech-time fraction settings: 12½ per cent, 25 per cent, 37½ per cent, 50 per cent, and 75 per cent. Five of the groups of stimulus words were each presented at one of the stated speech-time fraction settings with speech interrupted at two interruptions per second; the other five groups of stimulus words were each presented at one of the stated speech-time fraction settings with three interruptions per second.

The 110 stimulus words were presented under two test conditions: first, *without* an accompanying set of pictures; then, *with* pictures. Under picture conditions, four pictures arranged according to the PPVT format were presented with each stimulus word. One of the pictures was appropriate for the word. In each case the stimulus word was presented at the end of a carrier phrase, "Show me (car)," as suggested in the directions for administering the PPVT. The subject was also asked to repeat the word he heard. When the picture accompanied the stimulus, the subject was to point to the picture as well as to repeat what he heard. Subjects were given a 10-minute relief period of play between the two test condition presentations.

Since it was not possible to bring children to a central location, they were tested in their own locale, in the most quiet room available. Because the very young children could not tolerate a headset for long periods, the stimuli were presented via the tape recorder speaker without any additional instrument or earphone.

C. RESULTS

The results (see Tables 1 and 2) showed that improved performance on the auditory perception test accompanies advance in chronological age, with 5-year-olds' performance significantly poorer than that of the 6- and 7-year-old

TABLE 1
MEAN NUMBER OF CORRECT WORDS FOR AGES FIVE, SIX, SEVEN, AND EIGHT FOR EACH PER CENT OF SPEECH-ON TIME AT TWO INTERRUPTIONS PER SECOND

% of time speech is on	5 Yrs.		6 Yrs.		7 Yrs.		8 Yrs.	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
				Without pictures				
12½	.6500	.5723	1.0000	.0000	1.4500	.9206	1.5000	.7416
25	1.3000	.5568	2.5000	.5916	2.7500	.8292	2.8000	.8718
37½	3.1000	.7681	3.6000	.7348	4.0500	.5895	4.1500	.4770
50	4.3500	.6538	4.9000	.5385	5.3000	.6403	5.5500	.7399
75	7.7500	.8292	8.0500	.7399	8.2000	.7483	8.2000	.5099
				With pictures				
12½	2.0000	.8367	3.0500	.9206	3.3500	.7921	3.3000	.5568
25	3.4000	.7348	3.8000	.9274	4.1000	.7681	4.1500	.7921
37½	5.1500	.5723	5.4500	.5895	5.5000	.5916	6.8500	1.8241
50	7.3000	.8426	8.2000	.8718	9.2500	1.1779	10.4000	.7348
75	10.2000	.6782	10.1000	.7000	10.2500	.7665	10.7500	.5362

students. Older subjects' successes exceeded those of all other subjects. Comparisons between sexes yielded no significant differences. Results for the 6- and 7-year-old subjects agreed with Miller and Licklider's (2) findings that percentage of success was roughly equivalent to the percentage of time that speech was left on.

TABLE 2
MEAN NUMBER OF CORRECT WORDS FOR AGES FIVE, SIX, SEVEN, AND EIGHT FOR EACH PER CENT OF SPEECH-ON TIME AT THREE INTERRUPTIONS PER SECOND

% of time speech is on	5 Yrs.		6 Yrs.		7 Yrs.		8 Yrs.	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
				Without pictures				
12½	.9000	.8307	1.3000	.5568	1.5500	.4975	1.7000	.6403
25	1.9000	.6245	2.6000	.4899	2.8500	.5723	3.0000	.7071
37½	4.2000	.6782	4.2500	.6225	4.4000	.7348	4.4000	.5831
50	4.9000	.7000	5.3000	.7141	5.4500	.4975	5.5500	.4975
75	8.000	.7071	8.3500	.7263	9.2000	1.2083	9.5500	.4975
				With pictures				
12½	2.7500	.6982	3.2000	.6000	3.4000	1.0677	3.2000	.6000
25	4.1500	.6538	4.2000	.8718	4.2000	.6782	4.3000	.4583
37½	6.0000	.8944	6.5500	.6690	6.8000	1.8330	7.3000	2.0273
50	9.1000	.9434	9.2000	.7483	9.4000	.9695	10.7000	.4583
75	10.5500	.5895	10.8000	.4000	10.6500	.5723	10.9500	.2179

At all levels there was marked improvement in response with the addition of pictures. With pictures, even 5-year-old subjects performed better than did older subjects without pictures. Within age levels, performance with pictures surpassed performance without pictures in the next higher condition of speech-on time.

At three ips, performance was better than at two ips. There was also a tendency for performance curves to rise less steeply through successive age brackets at three ips than at two ips.

TABLE 3
COMPARISON OF MEANS BETWEEN AGES FOR EACH PER CENT OF SPEECH-ON TIME AT TWO INTERRUPTIONS PER SECOND

% of time speech is on	5-6 *t*	5-7 *t*	5-8 *t*	6-7 *t*	6-8 *t*	7-8 *t*
			Without pictures			
12½	2.66622*	3.21734**	3.95549**	2.13090*	2.93884**	.18437
25	6.43898**	6.32888**	6.32152**	1.06990	1.24126	.18116
37½	2.05033*	4.27705**	5.06227**	2.08232*	2.73677*	.57492
50	2.83039**	4.52505**	5.29756**	2.08400*	3.09609**	1.11368
75	1.17676	1.75627	2.01510**	.62131	.72762	.0000
			With pictures			
12½	3.67951**	5.10766**	5.63896**	1.07681	1.01299	.22511
25	1.47367	2.87047**	3.02577**	1.08601	1.25096	.19752
37½	1.59187	1.85362	3.87611*	.26098	3.18340**	3.06862**
50	3.23582**	5.86905**	12.08648**	3.12333**	8.41128**	3.61069**
75	.44722	.21296	2.77316**	.62992	3.21341**	2.33023*

* $p > .05$.
** $p > .01$.

The largest number of significant differences between means were seen in the contrast between the successes of the 5- and the 8-year-old groups (see Tables 3 and 4). There were fewer significant differences as the comparisons progressed from those between ages 5 and 6 to those between the 6- and 7-year-olds and the 7- and 8-year-olds. At each advance in age, significant

TABLE 4
COMPARISON OF MEANS BETWEEN AGES FOR EACH PER CENT OF SPEECH-ON TIME AT THREE INTERRUPTIONS PER SECOND

% of time speech is on	5-6 *t*	5-7 *t*	5-8 *t*	6-7 *t*	6-8 *t*	7-8 *t*
			Without pictures			
12½	1.74372	2.92651**	3.32501**	1.45970	2.05494*	.80641
25	3.84486**	4.88937**	5.08284**	1.44678	2.02699*	.71880
37½	.23676	.87182	.97477	.67897	.76669	.00000
50	1.74361	2.79181**	3.29941**	.75131	1.25218	.61966
75	1.50516	7.81506**	3.73621**	2.62819*	5.94252**	1.16755
			With pictures			
12½	2.13070*	2.22092*	2.13070*	.71180	.00000	.71180
25	.20001	.23135	.81895	.00000	.44262	.53256
37½	2.14654*	1.70973	2.55731*	.55847	1.53137	.79742
50	.36201	.96672	6.65039**	.71183	7.45162**	5.28438**
75	1.52983	.53062	2.77465**	.93652	1.43542	2.13571*

* $p > .05$.
** $p > .01$.

differences between means occurred in greater numbers at two ips than at three ips. In the two cases where differences were not statistically significant, there was a trend of increasing success with age.

D. Discussion

Several factors undoubtedly contribute to some ambiguity in the results of this investigation. The chief difficulty stems from the fact that the lists of stimulus words being compared are not phonetically balanced. The results of comparisons among the various conditions of amplitude modulation therefore are difficult to interpret. Despite this limitation the data, at least for the 6- and 7-year-olds, agree with those of Miller and Licklider (2) who did use phonetically balanced lists.

Success on this test increases with chronological age. Because other potential factors in such ability—namely, intelligence and familiarity with the stimulus words—were to some extent controlled in this study, auditory perception on this test at ages 5 through 8 may well be a function of physical maturity.

The investigator plans to extend the study to 3- and 4-year-old subjects whose performance, it is hypothesized, will lag behind those of the 5-year-olds.

E. Summary

Interrupted speech stimuli were presented with and without correlative pictures to subjects aged 5 through 8. Results showed a consistent increase in success with advance in chronological age. Pictures enhanced the possibility of success. The results suggest a relationship between physical maturation and success on the test.

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